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ADVANCED TECHNOLOGY MULTIPLE CRITERIA DECISION MODEL

UNIVERSITY OF DAYTON
SCHOOL OF ENGINEERING
DAYTON, OHIO 45469

NOVEMBER, 1981

FINAL REPORT FOR PERIOD 1 JUNE 1980 to 30 NOVEMBER 1981

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

AERO PROPULSION LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved for publication.

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This computerized model provides a flexible, interactive capability to solve problems involving multiple criteria. The decision model is capable of analyzing up to 10 different technology systems over 5 time increments. The program accepts up to 20 quantitative and qualitative parametric descriptions for each technology system. The program provides a system value comparison based on the technology data base and an evaluation of the relative importance of the parameters.

FOREWORD

This report prepared for the Aerospace Power Division, Aero Propulsion Laboratory, Wright-Patterson AFB, describes a computerized decision model capable of solving multiple criteria problems. The decision model is capable of analyzing up to 10 different technology systems over 5 time increments. Each technology system can be characterized by up to 20 quantitative and qualitative parametric descriptions for each technology system. A system value comparison is created based on the technology data base and an evaluation of the relative importance of the parameters.

The work reported herein was performed under project/task/work unit 3145/24/13 during the period 1 June 1980 to 30 November 1981, under the direction of Lt. Richard G. Honneywell, AFWAL/POOC, as project engineer. Dr. Patrick J. Sweeney, University of Dayton (School of Engineering), is technically responsible for the work.

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SECTION I

INTRODUCTION

1. BACKGROUND

Today's manager is often faced with the dilemma of selecting a course of action in the face of multiple and integrated goals or objectives. Rarely is a decision of any magnitude based solely on a single objective or goal. Instead, the decision maker often has several criteria upon which to base his decision. This program will assist the manager in his role as a decision maker by providing a flexible decision model that will analyze complex, multiple criteria decision problems. This decision model uses variable decision criteria and the analyst's evaluation of the relative importance of these criteria to select a preferred course of action. In addition, the model is structured to handle the change of the decision criteria values as a function of time. Results can be portrayed graphically as a function of time.

Suppose, for example, that one were tasked with the responsibility for selecting from a number of alternative weapon systems the weapon system that would best satisfy a particular mission. It is apparent that there would be many factors that would impact upon a decision of this magnitude. The potential destructive capability of the weapon system, the current research and development (R&D) program status, the expected improvements in the system as a function of time, the expected life cycle cost of the weapon system, etc., would significantly impact upon this decision. Initial cost would also certainly impact upon the economic feasibility of a particular weapon system.

It is also easily recognized that the factors noted above may vary in importance. It is in the model development and in the use of this particular technique that one identifies the criteria (parameters) that will be used in making that selection and then rates these parameters as a function of their importance. It can be seen that if the decision can be made at a future time, then the importance of particular parameters may change significantly with time. For example, the total ordnance delivery capability of a particular weapon system may vary significantly over a 25-year period. The R&D effort necessary and the expected results could significantly change the performance of a particular weapon system. It is with this in mind that the model was developed with the option to take into account the effects of change in parameter values as a function of time.

2. PURPOSE AND SCOPE

The purpose of this model is to provide a flexible, interactive computer program for use in multiple criteria decision problems. By following procedures provided interactively by the program on a computer terminal, the analyst is able to introduce the parameters, the data base, and the ratings of the parameters necessary to obtain a problem solution. The results are presented in tabular and graphic form.

3. GENERAL DESCRIPTION OF THE PROGRAM

The model consists basically of three major programs: the parameter package program (PPP); the user's preference package program (UPPP); and the system selection model program (SSMP).

The parameter package program allows the analyst to identify the parameters which are used as criteria in the decision model in choosing the optimal result and to enter the parameter data for each system. PPP creates two data files: PP (or the parameter package), which contains the parameter data, and HEADER, which contains the problem size and various names of systems, subsystems, and parameters.

The user's preference package program is used to evaluate and rate the parameters. UPP creates a third data file, UPP (or the user's preference package) containing the user's normalized ratings for the parameters. The user's preference package is constructed after the parameter package has been developed. It is necessary that those parameters identified in the parameter package program be the same parameters that are identified in the user's preference package program. In the UPPP, the analyst is given a choice of either identifying the importance of the parameters by using the paired comparison technique or using his own evaluation technique for determining the relative importance (ranking) of each parameter. The analyst then ranks the parameters from the most to the least important and rates each parameter accordingly with a value from 1 to 0. The analyst can establish different sets of ratings for different situations.

Data from these two packages are then used in the system selection model program. This program integrates the data from the two packages and utilizes this information in selecting the optimal solution as a function of the parameters discussed above.

As an example, suppose one is asked to make a decision as to which auxiliary power system should be selected, procured, and introduced into the Air Force inventory in the years 1980 to 2000. First, the analyst would select those parameters that would be used to differentiate among the power systems. For example, some parameters may be quantitative such as acquisition cost, life cycle cost, reliability, or other numerical descriptions of the systems. Once these parameters are identified, the corresponding values, either actual or forecasted, would be entered into the model. These values may be in units or dollars, gallons, or any form which enables the program to evaluate each specific parameter relative to each system. These parameters are next ranked and rated by the analyst according to the relative importance of each parameter in the set.

Certain parameter data may not be in a quantitative form. Therefore, the model has been structured to operate with nonquantitative data by using qualitative terms such as very poor, poor, fair, good, or excellent to define the values of particular nonquantitative parameters. In the model development of this selection problem, the analyst has defined the important parameters in this particular decision which would be applicable and has quantified the data relative to the systems under consideration.

The analyst must next evaluate the importance of each of the different parameters. As mentioned above, acquisition cost, life cycle cost, reliability, and other parameters have have been identified as important in this decision problem. In this particular portion of the program, referred to as the user's preference package, it is necessary for the analyst to rank all of the parameters on a scale from most important to least important. From this ranking, the analyst determines a rating for each of the parameters on a scale from 1 to 0.

For example, in the case mentioned above, the parameters may be ranked in order of importance by the decision maker as acquisition cost, reliability, life cycle cost, and other parameters. These rankings are next rated by the analyst from 1 to 0. Table 1 exemplifies this ranking methodology.

The analyst has now completed both the parameter package and the user's preference package programs. These data are automatically fed into the system selection model program

TABLE 1

RANKING/RATING EXAMPLE

Unranked Parameters	Parameter Ranking	Ranked Parameters	Parameter Rating
Acquisition Cost	1	Acquisition Cost	0.95
Life Cycle Cost	3	Reliability	0.80
Reliability	2	Life Cycle Cost	0.40
Other Parameters	4	Other Parameters	0.10

(SSMP) when in the interactive mode from a computer terminal. If desired, the SSMP outputs at the terminal the tabular and graphic data and, in this example, will show which systems should be procured in which years between 1980 and 2000.

Figure 1 shows how the three programs interact.

4. UNCERTAINTY OF THE DECISION MODEL

Rarely is an analyst certain that the data are absolutely correct. Neither is the analyst always confident as to which data are critical to the decision. Because of these uncertainties, it is important that current models address this topic of uncertainty.

In this multiple criteria decision model, uncertainty may exist in the values of the parameters in the parameter package and the values of the ratings in the user's preference package. The uncertainty associated with the parameters stems from the fact that all future parameter values are merely estimates and that current or past data may be biased by the system used in collecting the data. The user's preference ratings are at best subjective and may actually vary widely.

The example discussed earlier concerns the selection of power systems for the next twenty years. Obviously, the costs, performances, etc., will change over time, and estimating these factors up to twenty years hence can be risky indeed. No matter how exhaustive or expensive the data search, a guarantee of a certain value or future still does not exist. Therefore, the topic of uncertainty is important, especially when the decision model is used to predict a future condition.

When parameter data and user preferences are known to be one hundred percent accurate the results are risk free. However, this is rarely the case as the accuracy of future

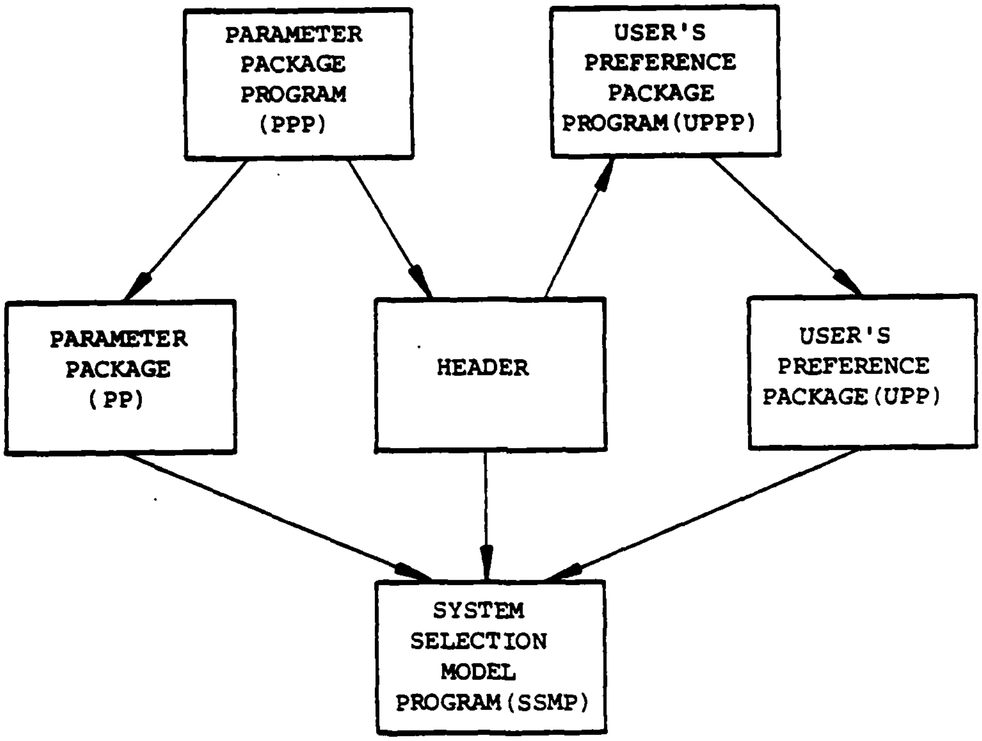

PARAMETER PACKAGE PROGRAM (PPP)
USER'S PREFERENCE PACKAGE PROGRAM(UPPP)
PARAMETER PACKAGE (PP)
HEADER
USER'S PREFERENCE PACKAGE(UPP)
SYSTEM SELECTION MODEL PROGRAM(SSMP)

Figure 1. Flow Sheet of Three Programs

values is always uncertain or risky. This model is not structured such that a direct computation of system values given parameter uncertainties is possible. The authors suggest the following approach to addressing uncertainty with this model. First, determine the most important parameters. This can be accomplished by selecting those parameters with the highest user preference values and/or the highest relative valued parameters. Second, test the sensitivity of the model to small changes in the items identified in step one by executing the model with individual parameter value changes. Third, by experience, additional data, or other methodology, determine reasonable ranges for the sensitive parameters. This will establish upper and lower limits on the important and model sensitive parameters. Fourth, execute the model using combinations of the above parameters throughout the ranges identified in step three. A compilation of many runs will provide a mapping of the effects of varying the sensitive parameter values. This mapping will be a visual display of the system value variability as a function of the uncertainty of the parameter data and/or user preferences.

SECTION II

PROGRAMMING STANDARDS

1. PORTABILITY FEATURES

The programs described in this report are written in standard ANSI FORTRAN IV. To enhance the portability of these programs and in order to allow the programs to be used on other computer systems, certain conventions are followed. These conventions include:

a. No more than five continuation cards are used.

b. A maximum field width of four is used for the alpha numeric format, i.e., A4. This may differ in the graphics program.

c. No EQUIVALENCE statements are used.

d. Unit numbers in input/output statements appear as variables, and their values are located in a DATA statement. This feature allows modification of the unit numbers with one statement change.

e. Hollerith formatting is used exclusively.

2. PROVISIONS FOR FUTURE MODIFICATION

The system selection model programs are designed to allow easy modification and expansion.

Features include:

a. The same variable names and labeled COMMON statements are used throughout all programs but the graphics program. This is because the graphics programs are machine-dependent, and changes to the programs may be extensive if the program is to be used on another computer system.

b. The input/output unit numbers can be modified easily by changing the appropriate DATA statements in the BLOCK DATA module in each program.

c. The do-loop indices, where applicable, are given by integer variables in place of constants.

d. The graphics programs are optional. As a separate segment they are easy to drop from the model.

e. The PROCEDURE files coordinate the attaching and returning of the data files. The PROCEDURE files are for convenience and have no bearing on the programs themselves.

f. If the programs are to be modified to run larger problems, the user should consult Table 2, to help facilitate array changes. Another program called system selection model program in background (SSMPB) is set up to run the larger problems. For further information consult Appendix B.

3. POTENTIAL DIFFICULTIES

Some features which may potentially cause problems include:

a. Labeled COMMONs are used.

b. Unformatted input/output is used.

c. The program SSMP and the two graphics programs are overlaid. Overlaying was used to allow these large programs to run interactively. The overlays can be changed to subroutines by: (1) deleting the OVERLAY cards; (2) changing PROGRAM cards to SUBROUTINE; (3) adding RETURN statements; and (4) changing CALL statements to call the subroutines.

d. The programs are executed using PROCEDURE files to attach and return data files. This feature allows the user to specify a different file name for each problem. PROCEDURE files are system-dependent; for further information, see Section IV.3.

TABLE 2

ARRAYS THAT CAN BE MODIFIED

Labeled COMMON Name	Array Name
/HDR1/	SUB1NM(NSUB1,4)
	SUB2NM(NSUB1,NSUB2,4)
	PARNAM(NPARM,4)
	NUM(NPARM)
	RATED(NPARM)
	YN(NPARM)
	INVERT(NPARM)
/HDR1/	SCNDSC(NSCEN,15)
/PARAM1/	CHPRM(NPARM)
	ABV(NPARM)
	BELW(NPARM)
	RLOWR(NPARM)
	HIR(NPARM)
	RTD(NPARM)
	IRANGE(NPARM)
	ISWNO(NPARM)
/PARAM2/	ELIM(INDEX,10,NPARM)
/PARAM3/	MATRIX(NPARM,INDEX,10)
/PARAM4/	SYSNRM(INDEX,10)
/RTG/	RTING(NPARM)
/RTNG/	RATING(NSCEN,NPARM)
/RTING/	RATING(NPARM)
None	PARAM(INDEX,10)
	VPARAM(INDEX,10)
	ICOUNT(NPARM)
	IORDER(NPARM)
	ICNT(NPARM)
	PSUM(NPARM)
	PAVE(NPARM)

Notes: NSUB1 = Number of Level 1 Subsystems
NSUB2 = Number of Level 2 Subsystems
NPARM = Number of Parameters
INDEX = 1 for Case 1*
NSUB1 for Case 2
NSUB1 x NSUB2 for Case 3

* For an explanation of Cases 1, 2, and 3, see Section IV, 1.a page 15.

SECTION III

ENVIRONMENT AND INTERFACES

1. SYSTEM DESCRIPTION

The development of the system selection model programs has been conducted on the Wright-Patterson Air Force Base ASD computer system. Two large CDC computers support ASD, a CDC CYBER 175 and a CDC CYBER 74. The systems are for two different functions. The CYBER 175 is used for interactive support, while the CYBER 74 is used for batch processing and interactive graphics. It is possible to enter jobs on one computer system and have it processed on the other. This ability is due to the fact that both systems are architecturally compatible and share the same permanent disk facilities and tape drives. For further information, consult the Introduction to ASD Computer Center Guide (1).

2. HARDWARE CHARACTERISTICS AND CONSTRAINTS

Both systems have a large amount of central memory available. The CYBER 175 has 262,000 (60 bit) words, and the CYBER 74 has 131,000 words. Each system has 20 peripheral processing units available for input/output. Each system can handle 12 jobs in central memory at one time. Jobs not yet processed remain in queues. High speed readers of 1,200 characters per minute (cpm), card punches of 250 characters per minute, and line printers at 1,200 lines per minute (lpm) are available. There exist at present 7- and 9-track tape drives, with the 9-track tape drives capable of handling up to 6,250 bits per minute (bpm). The hardware facilities also include a 3.3 billion 6-bit character disk storage capability, with approximately 2.4 billion bytes available for user permanent file storage.

3. SOFTWARE ENVIRONMENT

The operating system in current use on the CDC systems is the Network Operating System/Batch Environment (NOS/BE). The decision model programs were developed on the CDC INTERCOM software. INTERCOM is the CDC software that supports the interactive access to the CDC computer system.

4. INTERFACE CHARACTERISTICS

The system selection model progam (SSMP) will produce, as an option, TEKTRONIX graphs as output. TEKTRONIX graphics are accessed through a number of FORTRAN subroutines. The TEKTRONIX software used is PLOT-10/Advanced Graphics-II. For best results, the graphics program should be executed on a TEKTRONIX terminal that has at least a 5" X 7" screen. Terminals that are adequate include the TEKTRONIX 4010, 4051, and 4052 terminals.

SECTION IV

FEATURES OF THE PROGRAM

1. FUNCTIONAL OVERVIEW AND CAPABILITIES

The system selection model program (SSMP) determines the optimal, or best system from a number of choices. A problem must be able to meet certain specifications in order to execute SSMP.

a. Choices as Systems

The choices are termed systems. Sometimes the choices are complex and can be broken down into subsystems. As an example, a student must choose among different colleges. This student also cannot make up his/her mind as to which major he/she should take when attending college. Assume that the four choices of majors are chemical engineering, mechanical engineering, finance, and accounting. Assuming that the student can get accepted into any college with any choice of major, the problem can be set up as shown in Figure 2. In this figure, college is the system, the schools of business and engineering are level 1 subsystems, and the various departments are level 2 subsystems.

The breakdown of the system into subsystems is optional. The case where systems are not broken into subsystems is labeled Case 1. Case 2 is when the system is broken down into one level of subsystems. Case 3 is when the system is broken down into two levels of subsystems, as in this example.

To continue further with the example, the student specifies the colleges as: Harvard, Massachusetts Institute of Technology, University of Dayton, California Institute of Technology, and Yale. This particular problem needs to expand to include level 1 and level 2 subsystems, and it must do so in what is called a "balanced" fashion. That is, there

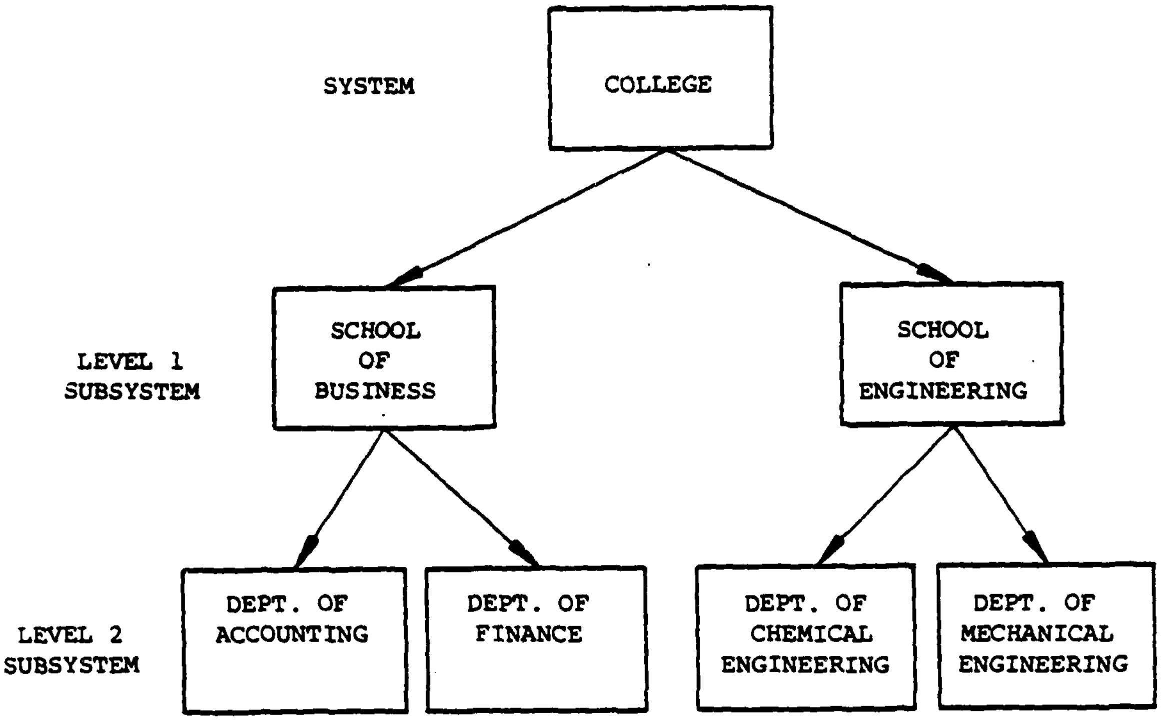


Figure 2. Problem Tree for College Selection Problem

must be at least two level 1 subsystems; if only one is desired, then another must be entered into the model to create a "balanced" tree. This may be accomplished by entering a level 1 subsystem named "BLANK" and entering zeros for its parameter data so that it does not influence the decision. Similarly, each level 1 subsystem must have at least two level 2 subsystems, and each must be broken down into the same number of level 2's. Of course, if the particular problem is Case 1 or 2, that is, deals only with systems or with systems and level 1's, then the stipulations on level 1 or level 2 subsystems may be ignored as they do not enter into the problem tree.

b. Determination of Parameters

The parameters to be used in judging the colleges must be determined. Some of the parameters for this example might include tuition, reputation of school, number of students in department, etc. The program recognizes three different types of parameters: (1) numerical (for example, tuition); (2) rated (for example, reputation of school can be specified as excellent, good, etc.); and (3) qualifying to indicate whether or not a system possesses a certain quality (such as off-campus housing for freshmen). The system will be eliminated if it does not possess the quality; data is entered in a yes/no form.

Several examples of this college selection problem appear in Appendix C.

Problems such as this example can be run interactively so long as the problem size is not too large. To execute these programs interactively on Wright-Patterson's CDC CYBER 175, the problem size is limited to:

(1) No more than 10 systems.

(2) No more than 40 parameters.

(3) No more than the product of seven for level 1 and level 2 subsystems. For example:

(a) Seven level 1 subsystems and no level 2 subsystems.

(b) Two level 1 subsystems and three level 2 subsystems.

(c) Three level 1 subsystems and two level 2 subsystems.

If the problem size is larger, the problem can be run in background or batch by changing the appropriate dimensions in the COMMON statements. The only limit that cannot be changed without some rewriting of the program is the number of systems. For instructions and examples on running SSMPB see Appendix B.

The user should consider the special case where time appears as a subsystem. If a problem's parameter data change with time, SSMP can be used to forecast the optimal system in the future. Within the graphics capability of the program a special program is available which provides a time graph for the specific problem of choosing the optimal system for five time intervals when time is a level 1 or 2 subsystem. This graph is different from the other graphs created by the normal histogram graphics feature, in that it plots time versus the system values. If the user believes that the output available is inadequate for his needs, the user can add other output routines rather easily. For more information on modification of these programs see Section II.

2. INPUT AND OUTPUT

This section describes line-by-line how to execute the parameter package program (PPP), the user's preference package program (UPPP), and the system selection model program (SSMP). Examples are provided to help illustrate each program. A generator selection problem is used as an example of a Case 3 problem where four generators are the systems; the power sizes, 250 kW, 50 kW, and 10 kW are level 1 subsystems; and the level 2 subsystems are the years 1980 and 2000. The problem tree for the generator selection problem is shown in Figure 3.

a. Input

(1) Parameter package program (PPP) to create the HEADER file.

For PPP (using the command CRTE) to set up the data file HEADER, the user is required to specify:

(a) Data base name: specifies the problem name and should contain no more than 16 alphanumeric characters. If more than 16 characters are entered, the program truncates the name.

(b) Number of systems should not exceed ten.

(c) Number of level 1 subsystems: enter as a two-digit number; this specifies the number of level 1 subsystems per system.

(d) Number of level 2 subsystems: these specify the number of level 2 subsystems per level 1 subsystems and are entered as a two-digit number. If no subsystems are desired, be sure to enter the appropriate zeros. Also, level 2 subsystems cannot be specified if no level 1 subsystems exist.

(e) Number of parameters: enter as a two-digit number; the value should not exceed the value of 40 for the interactive version of SSMP.

(f) System setname: specifies the setname for the system. For example, the system setname for the diesel engine and Stirling engine could be generators. The setname should contain no more than 16 alphanumeric characters.

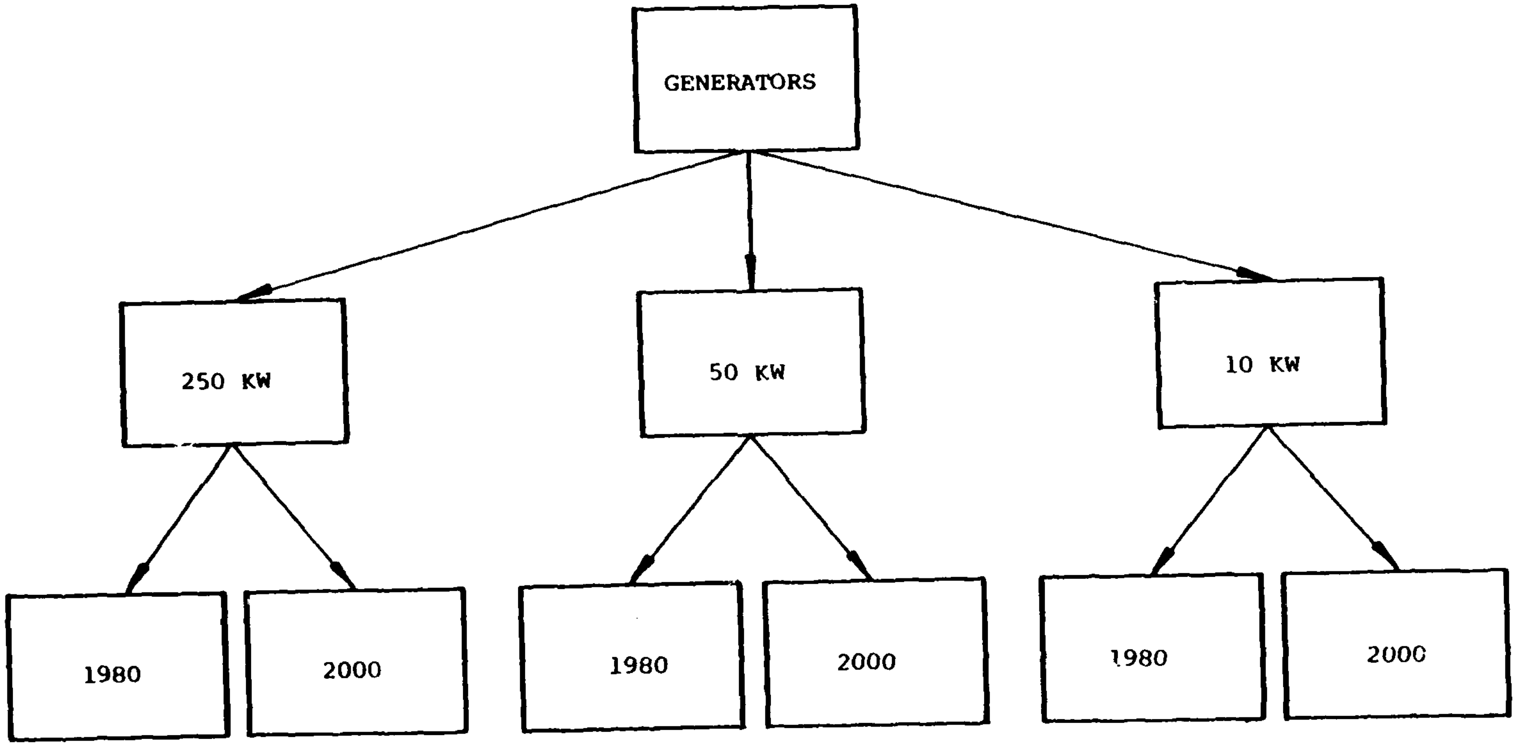


Figure 3. Problem Tree for Generator Selection Problem

(g) System names: these specify the specific names for each system, and each should have no more than 16 alphanumeric characters.

(h) Level 1 subsystem setname: if level 1 subsystems have been opted, the user enters the setnames describing the level 1 subsystems. A maximum of 16 alphanumeric characters is allowed.

(i) Level 1 subsystems names: if the level 1 subsystem option has been chosen, the user enters the specific names for the level 1 subsystems. A maximum of 16 alphanumeric characters is allowed.

(j) Level 2 subsystem setname: if the level 2 subsystems option has been chosen, the user enters the setnames describing the level 2 subsystems. A maximum of 16 alphanumeric characters is allowed.

(k) Level 2 subsystem names: if the level 2 subsystems option has been chosen, the user enters the specific names for the level 2 subsystems. A maximum of 16 alphanumeric characters is allowed.

(l) Parameter name: the parameter names are entered, and a maximum of 16 alphanumeric characters is allowed.

(m) Type of parameter: the user is required to identify the type of parameter, either numerical, rated or qualitative. When the parameter is specified numerically, the user is asked whether or not he wishes to invert the parameter. The SSMP determines the best system from the numerical data by considering the lowest values as the best value. See Appendix A for the inverting algorithm. In cases where this method of inverting may prove to be unsatisfactory, the user must treat the parameter data with a more appropriate method before entering it in the parameter package program (PPP). Of course, the user should not indicate that the data are to be inverted if the data have already been inverted by some other means.

If the parameter is specified as a rated parameter, the user can describe the parameter in terms of very poor, poor, fair, good, or excellent. The program assigns numerical values to the ratings, and SSMP evaluates the parameters on the basis of these relative values.

If the parameter is specified as a qualifying parameter, this parameter is used to check whether or not the systems and its subsystems have this qualifier. If not, that system or subsystem is eliminated from the decision process. See Figure 4 for an example using the generator selection problem.

(2) Parameter package program (PPP) to create the parameter package (PP) file.

For PPP (using the command MNIN) to set up the data file PP, the user is required to specify:

(a) For a numerical parameter: the numerical data, in any format, of that system or subsystem.

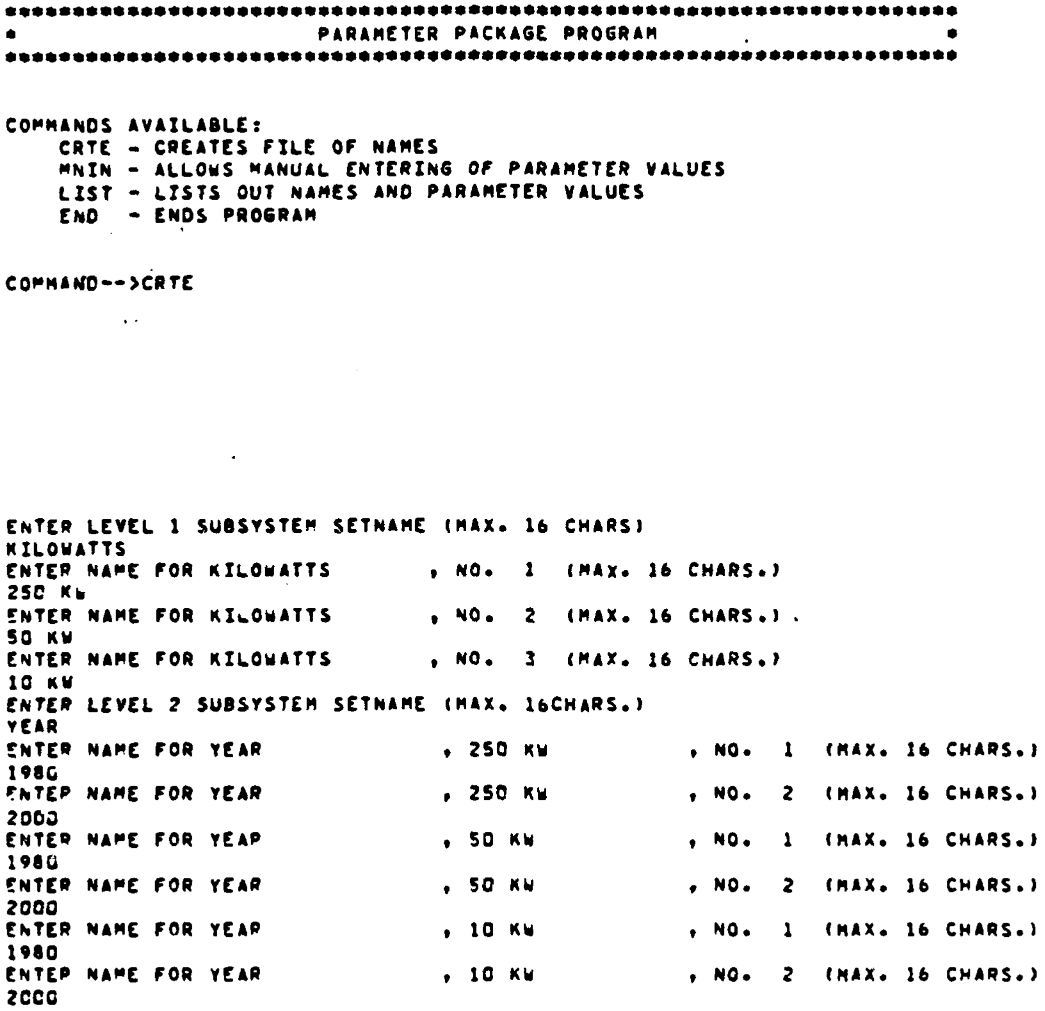
(b) For a rated parameter: the rating of that system or subsystem.

(c) For a qualifying parameter: the user specifies whether or not that system or subsystem has that qualifier.

(3) User's preference package program to create the user's preference package (UPP) file.

For UPPP (using the command CRTE) to set up the data file UPP, the user is required to specify:

(a) Number of scenarios: scenarios describe the different situations where the rating values for the parameters would differ. For example, in the college selection problem, emphasis might shift for some parameters depending on how much a student could afford. Therefore,



```
************************************************************************
*                       PARAMETER PACKAGE PROGRAM                      *
************************************************************************


COMMANDS AVAILABLE:
    CRTE - CREATES FILE OF NAMES
    MNIN - ALLOWS MANUAL ENTERING OF PARAMETER VALUES
    LIST - LISTS OUT NAMES AND PARAMETER VALUES
    END  - ENDS PROGRAM


COMMAND-->CRTE







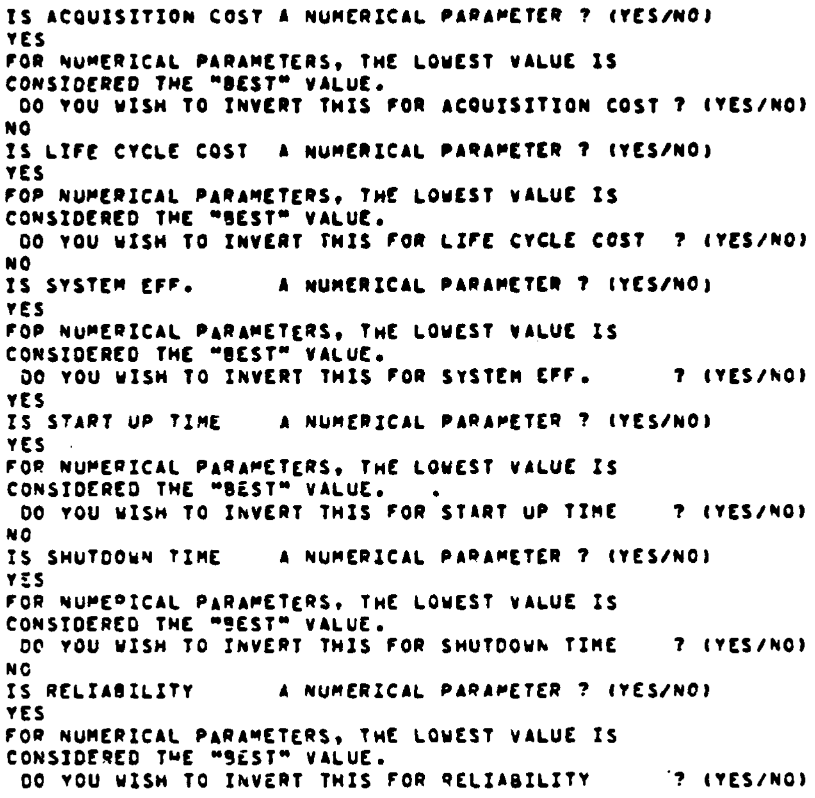

ENTER LEVEL 1 SUBSYSTEM SETNAME (MAX. 16 CHARS)
KILOWATTS
ENTER NAME FOR KILOWATTS       , NO.  1  (MAX. 16 CHARS.)
250 KW
ENTER NAME FOR KILOWATTS       , NO.  2  (MAX. 16 CHARS.)
50 KW
ENTER NAME FOR KILOWATTS       , NO.  3  (MAX. 16 CHARS.)
10 KW
ENTER LEVEL 2 SUBSYSTEM SETNAME (MAX. 16CHARS.)
YEAR
ENTER NAME FOR YEAR             , 250 KW           , NO.  1  (MAX. 16 CHARS.)
1980
ENTER NAME FOR YEAR             , 250 KW           , NO.  2  (MAX. 16 CHARS.)
2000
ENTER NAME FOR YEAR             , 50 KW            , NO.  1  (MAX. 16 CHARS.)
1980
ENTER NAME FOR YEAR             , 50 KW            , NO.  2  (MAX. 16 CHARS.)
2000
ENTER NAME FOR YEAR             , 10 KW            , NO.  1  (MAX. 16 CHARS.)
1980
ENTER NAME FOR YEAR             , 10 KW            , NO.  2  (MAX. 16 CHARS.)
2000
```

Figure 4 - Generator Selection Problem Using PPP With Command CRTE

```
ENTER LEVEL 1 SUBSYSTEM SETNAME (MAX. 16 CHARS)
KILOWATTS
ENTER NAME FOR KILOWATTS         , NO.  1  (MAX. 16 CHARS.)
250 KW
ENTER NAME FOR KILOWATTS         , NO.  2  (MAX. 16 CHARS.)
50 KW
ENTER NAME FOR KILOWATTS         , NO.  3  (MAX. 16 CHARS.)
10 KW
ENTER LEVEL 2 SUBSYSTEM SETNAME (MAX. 16CHARS.)
YEAR
ENTER NAME FOR YEAR              , 250 KW           , NO.  1  (MAX. 16 CHARS.)
1980
ENTER NAME FOR YEAR              , 250 KW           , NO.  2  (MAX. 16 CHARS.)
2000
ENTER NAME FOR YEAR              , 50 KW            , NO.  1  (MAX. 16 CHARS.)
1980
ENTER NAME FOR YEAR              , 50 KW            , NO.  2  (MAX. 16 CHARS.)
2000
ENTER NAME FOR YEAR              , 10 KW            , NO.  1  (MAX. 16 CHARS.)
1980
ENTER NAME FOR YEAR              , 10 KW            , NO.  2  (MAX. 16 CHARS.)
2000
```

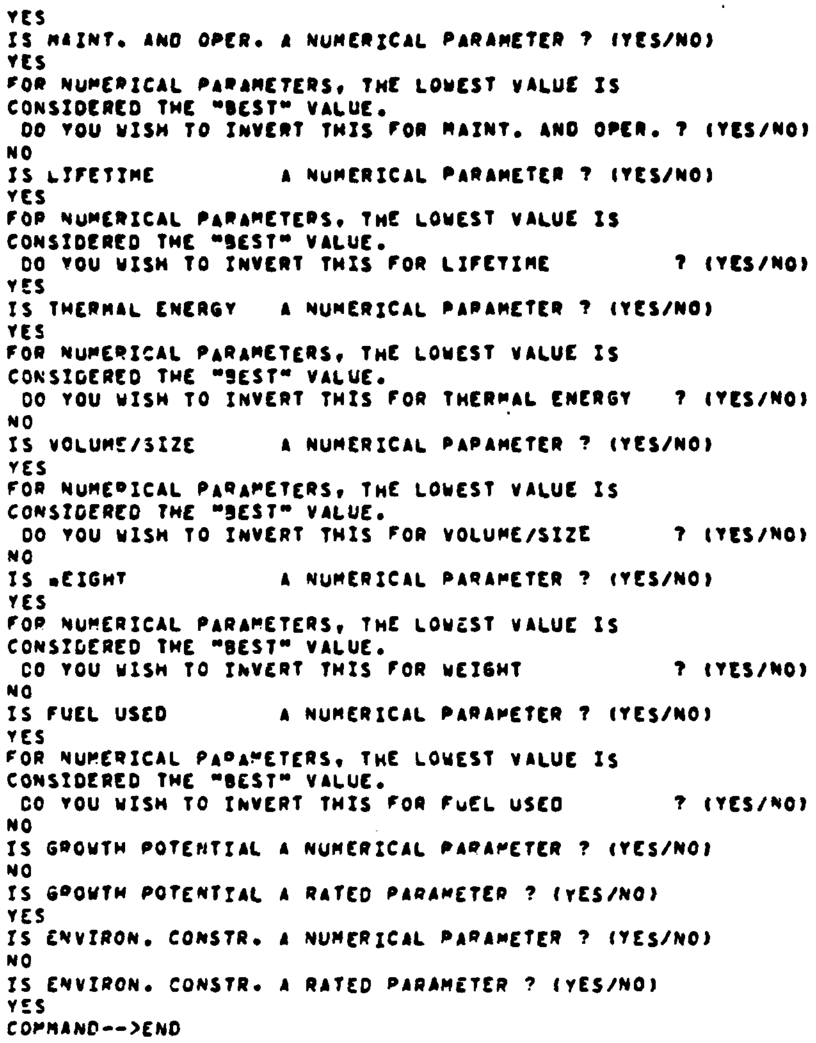
```
ENTER NAME FOR PARAMETER NO. 1
ACQUISITION COST
ENTER NAME FOR PARAMETER NO. 2
LIFE CYCLE COST
ENTER NAME FOR PARAMETER NO. 3
SYSTEM EFF.
ENTER NAME FOR PARAMETER NO. 4
START UP TIME
ENTER NAME FOR PARAMETER NO. 5
SHUTDOWN TIME
ENTER NAME FOR PARAMETER NO. 6
RELIABILITY
ENTER NAME FOR PARAMETER NO. 7
MAINT. AND OPER.
ENTER NAME FOR PARAMETER NO. 8
LIFETIME
ENTER NAME FOR PARAMETER NO. 9
THERMAL ENERGY
ENTER NAME FOR PARAMETER NO.10
VOLUME/SIZE
ENTER NAME FOR PARAMETER NO.11
WEIGHT
ENTER NAME FOR PARAMETER NO.12
FUEL USED
ENTER NAME FOR PARAMETER NO.13
GROWTH POTENTIAL
ENTER NAME FOR PARAMETER NO.14
ENVIRON. CONSTR.
```

Figure 4 - Continued



```
IS ACQUISITION COST A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR ACQUISITION COST ? (YES/NO)
NO
IS LIFE CYCLE COST  A NUMERICAL PARAMETER ? (YES/NO)
YES
FOP NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR LIFE CYCLE COST  ? (YES/NO)
NO
IS SYSTEM EFF.      A NUMERICAL PARAMETER ? (YES/NO)
YES
FOP NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR SYSTEM EFF.      ? (YES/NO)
YES
IS START UP TIME    A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR START UP TIME    ? (YES/NO)
NO
IS SHUTDOWN TIME    A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMEPICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DC YOU WISH TO INVERT THIS FOR SHUTDOWN TIME    ? (YES/NO)
NC
IS RELIABILITY      A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR PELIABILITY      ? (YES/NO)
```

Figure 4 - Continued



```
YES
IS MAINT. AND OPER. A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR MAINT. AND OPER. ? (YES/NO)
NO
IS LIFETIME         A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR LIFETIME         ? (YES/NO)
YES
IS THERMAL ENERGY   A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR THERMAL ENERGY   ? (YES/NO)
NO
IS VOLUME/SIZE      A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR VOLUME/SIZE      ? (YES/NO)
NO
IS WEIGHT           A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR WEIGHT           ? (YES/NO)
NO
IS FUEL USED        A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR FUEL USED        ? (YES/NO)
NO
IS GROWTH POTENTIAL A NUMERICAL PARAMETER ? (YES/NO)
NO
IS GROWTH POTENTIAL A RATED PARAMETER ? (YES/NO)
YES
IS ENVIRON. CONSTR. A NUMERICAL PARAMETER ? (YES/NO)
NO
IS ENVIRON. CONSTR. A RATED PARAMETER ? (YES/NO)
YES
COMMAND-->END
```

Figure 4 - Concluded

several different scenarios could be set up. As examples, one scenario could give the student no limit on his tuition expenses while another scenario might show the student as having a $2,000 scholarship. Therefore, the ratings on some parameters might vary from scenario to scenario. There is a maximum limit of 25 scenarios.

(b) Scenario description: the user can enter up to 60 alphanumeric characters describing each scenario.

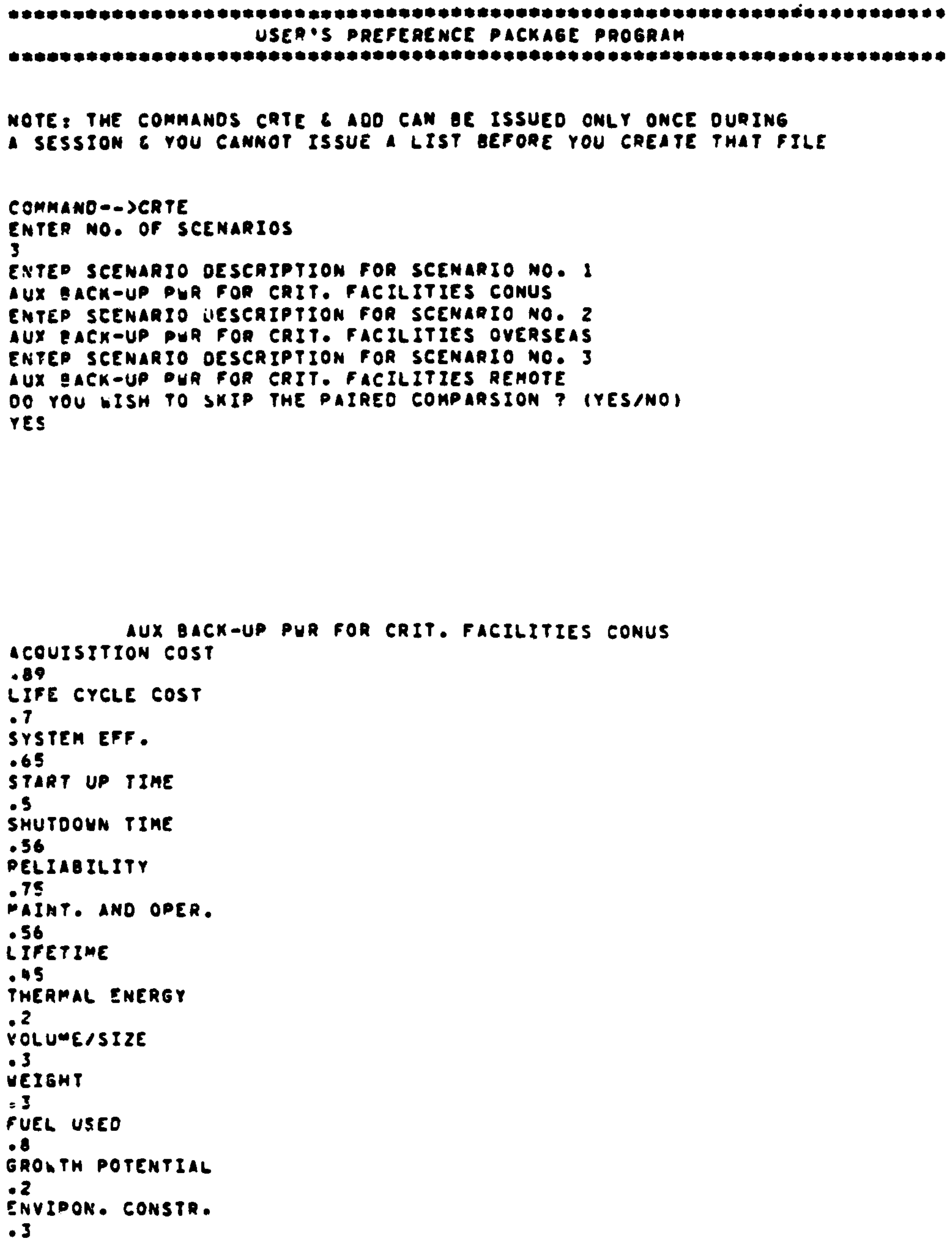
To choose how to rate the parameters the user should specify:

(i) Paired comparison: the user can rank the parameters in importance by comparing pairs of parameters and choosing which parameter is more important than the other.

(ii) Directly rate the parameters: if the user performs the paired comparison, the program ranks the parameters and the user specifies a rating from 0 to 1. If the paired comparison is not chosen, the parameters are not ranked, and the user just rates the parameter from 0 to 1. For UPPP (using the ADD command) the user can add additional scenarios to the data file UPP. The only difference between this command and the command CRTE is that the user specifies the number of scenarios to be added. See Figure 5 for an example of the generator selection problem using UPPP with the commands CRTE and LIST.

(4) System selection model program (SSMP)

To perform the decision process, the user is required to specify the user's choice of either entering parameter ratings or using the parameter ratings that are set up in the scenarios in the UPP data file. SSMP asks the user, "Do you wish to enter your own ratings?" If yes, the



```
******************************************************************************
                        USER'S PREFERENCE PACKAGE PROGRAM
******************************************************************************


NOTE: THE COMMANDS CRTE & ADD CAN BE ISSUED ONLY ONCE DURING
A SESSION & YOU CANNOT ISSUE A LIST BEFORE YOU CREATE THAT FILE


COMMAND-->CRTE
ENTER NO. OF SCENARIOS
3
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 1
AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 2
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 3
AUX BACK-UP PWR FOR CRIT. FACILITIES REMOTE
DO YOU WISH TO SKIP THE PAIRED COMPARSION ? (YES/NO)
YES



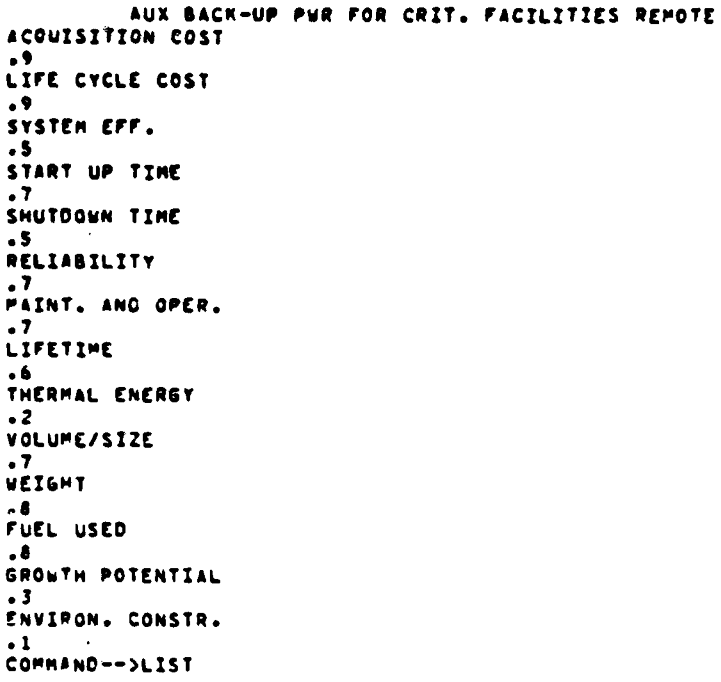



         AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS
ACQUISITION COST
.89
LIFE CYCLE COST
.7
SYSTEM EFF.
.65
START UP TIME
.5
SHUTDOWN TIME
.56
RELIABILITY
.75
MAINT. AND OPER.
.56
LIFETIME
.45
THERMAL ENERGY
.2
VOLUME/SIZE
.3
WEIGHT
.3
FUEL USED
.8
GROWTH POTENTIAL
.2
ENVIRON. CONSTR.
.3
```

Figure 5 - Generator Selection Problem Using UPPP With Command CRTE

```
          AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS
ACQUISITION COST
.9
LIFE CYCLE COST
.87
SYSTEM EFF.
.76
START UP TIME
.6
SHUTDOWN TIME
.6
RELIABILITY
.8
MAINT. AND OPER.
.8
LIFETIME
.5
THERMAL ENERGY
.2
VOLUME/SIZE
.6
WEIGHT
.6
FUEL USED
.7
GROWTH POTENTIAL
.2
ENVIRON. CONSTR.
.1
```

Figure 5 - Continued



```
         AUX BACK-UP PWR FOR CRIT. FACILITIES REMOTE
ACQUISITION COST
.9
LIFE CYCLE COST
.9
SYSTEM EFF.
.5
START UP TIME
.7
SHUTDOWN TIME
.5
RELIABILITY
.7
MAINT. AND OPER.
.7
LIFETIME
.6
THERMAL ENERGY
.2
VOLUME/SIZE
.7
WEIGHT
.8
FUEL USED
.8
GROWTH POTENTIAL
.3
ENVIRON. CONSTR.
.1
COMMAND-->LIST
```

Figure 5 - Concluded

user enters a scenario description with a limit of 60 alphanumeric characters and parameter ratings ranging from 0 to 1. If no, the program prints out the available scenarios and the user chooses a scenario.

The user then chooses the number of parameters to be included in the decision process.

(a) Parameter choices: the user enters the integer number associated with the chosen parameters. The integer numbers must be entered from the lowest to the highest values.

(b) Parameter limits: the user can specify a limit on the parameters so that any systems or subsystems that do not satisfy this limit are eliminated from the decision process.

(i) If the parameter is numerical, the user can specify a numerical limit of greater than, lesser than, or both.

(ii) If the parameter is rated, the user can specify a rating that the parameter data has to satisfy or exceed.

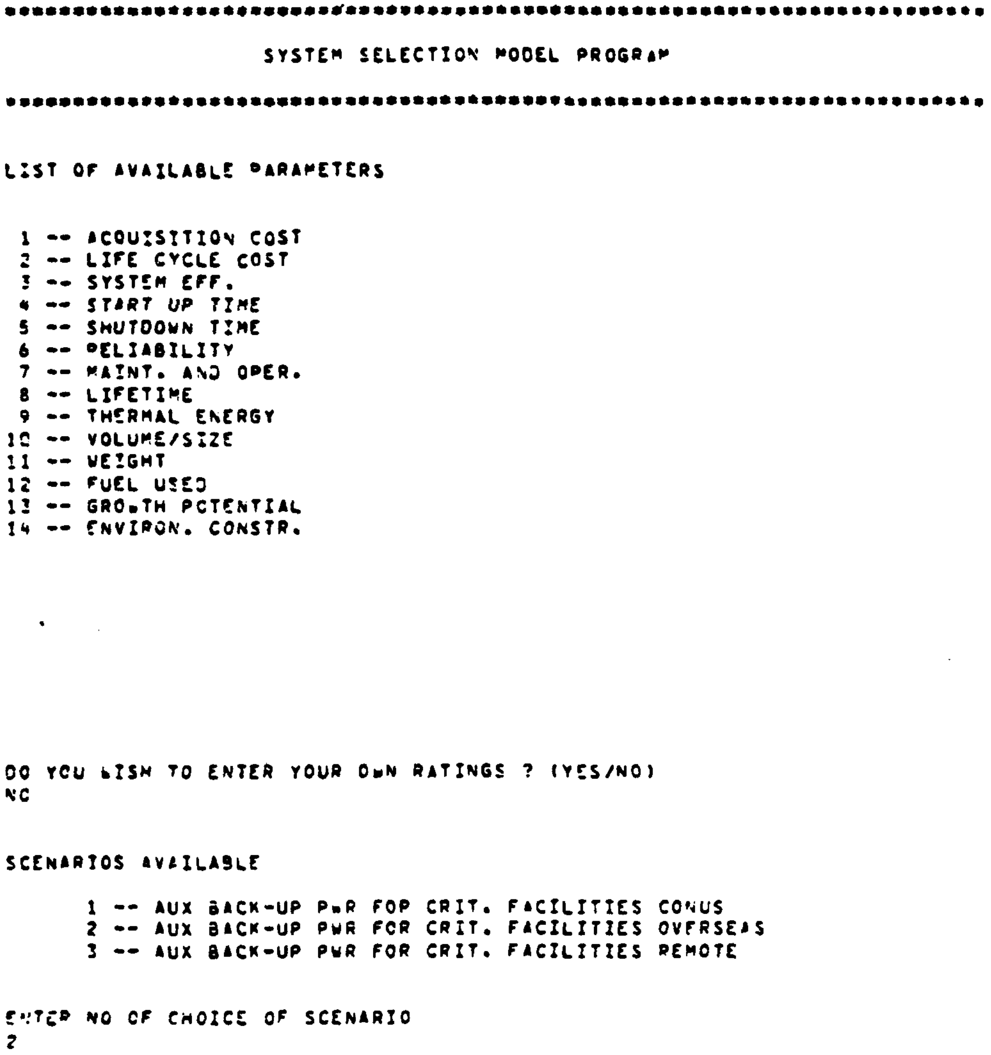
(iii) If the parameter is qualifying, the user cannot specify a limit because the parameter either has that quality or does not.

(c) Choice of output: the user can choose between tabular, graphic, or both.

(i) If no graphic output is desired, the user can execute the program again.

(ii) If graphic output is chosen, the user can choose the standard graphic output or the time versus system rating graph, depending on whether or not time is a subsystem.

See Figure 6 for an example of the generator selection problem using SSMP.



```
**********************************************************************

                     SYSTEM SELECTION MODEL PROGRAM

**********************************************************************

LIST OF AVAILABLE PARAMETERS

 1 -- ACQUISITION COST
 2 -- LIFE CYCLE COST
 3 -- SYSTEM EFF.
 4 -- START UP TIME
 5 -- SHUTDOWN TIME
 6 -- RELIABILITY
 7 -- MAINT. AND OPER.
 8 -- LIFETIME
 9 -- THERMAL ENERGY
10 -- VOLUME/SIZE
11 -- WEIGHT
12 -- FUEL USED
13 -- GROWTH POTENTIAL
14 -- ENVIRON. CONSTR.





DO YOU WISH TO ENTER YOUR OWN RATINGS ? (YES/NO)
NO

SCENARIOS AVAILABLE

      1 -- AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS
      2 -- AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS
      3 -- AUX BACK-UP PWR FOR CRIT. FACILITIES REMOTE

ENTER NO OF CHOICE OF SCENARIO
2
```

Figure 6 - Generator Selection Problem Using SSMP

```
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS

      ****************************************
      *         PARAMETERS         * RATINGS *
      ****************************************
      *     ACQUISITION COST       *   .900  *
      *     LIFE CYCLE COST        *   .870  *
      *     SYSTEM EFF.            *   .760  *
      *     START UP TIME          *   .600  *
      *     SHUTDOWN TIME          *   .600  *
      *     RELIABILITY            *   .900  *
      *     MAINT. AND OPER.       *   .900  *
      *     LIFETIME               *   .500  *
      *     THERMAL ENERGY         *   .230  *
      *     VOLUME/SIZE            *   .630  *
      *     WEIGHT                 *   .600  *
      *     FUEL USED              *   .700  *
      *     GROWTH POTENTIAL       *   .200  *
      *     ENVIRON. CONSTR.       *   .100  *
      ****************************************

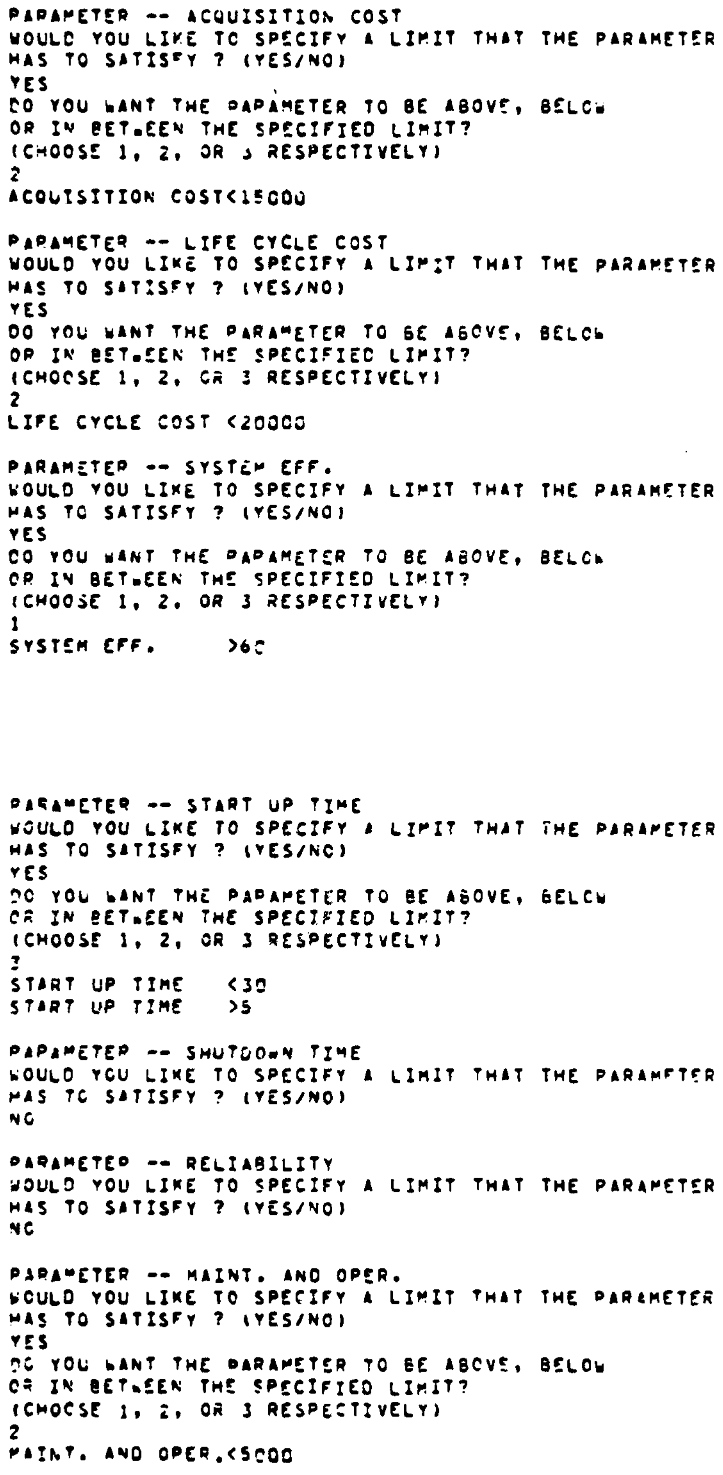



ENTER THE NUMBER OF PARAMETERS TO BE INCLUDED IN THE DECISION PROCESS
14

ENTER EACH INTEGER NO. ASSOCIATED WITH EACH CHOSEN
PARAMETER (FROM LOWEST TO HIGHEST)

 PARAMETER NO. --1
 PARAMETER NO. --2
 PARAMETER NO. --3
 PARAMETER NO. --4
 PARAMETER NO. --5
 PARAMETER NO. --6
 PARAMETER NO. --7
 PARAMETER NO. --8
 PARAMETER NO. --9
 PARAMETER NO. --10
 PARAMETER NO. --11
 PARAMETER NO. --12
 PARAMETER NO. --13
 PARAMETER NO. --14
```

Figure 6 - Continued



```
PARAMETER -- ACQUISITION COST
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
YES
DO YOU WANT THE PARAMETER TO BE ABOVE, BELOW
OR IN BETWEEN THE SPECIFIED LIMIT?
(CHOOSE 1, 2, OR 3 RESPECTIVELY)
2
ACQUISITION COST<15000

PARAMETER -- LIFE CYCLE COST
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
YES
DO YOU WANT THE PARAMETER TO BE ABOVE, BELOW
OR IN BETWEEN THE SPECIFIED LIMIT?
(CHOOSE 1, 2, OR 3 RESPECTIVELY)
2
LIFE CYCLE COST <20000

PARAMETER -- SYSTEM EFF.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
YES
DO YOU WANT THE PARAMETER TO BE ABOVE, BELOW
OR IN BETWEEN THE SPECIFIED LIMIT?
(CHOOSE 1, 2, OR 3 RESPECTIVELY)
1
SYSTEM EFF.      >60




PARAMETER -- START UP TIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
YES
DO YOU WANT THE PARAMETER TO BE ABOVE, BELOW
OR IN BETWEEN THE SPECIFIED LIMIT?
(CHOOSE 1, 2, OR 3 RESPECTIVELY)
3
START UP TIME    <30
START UP TIME    >5

PARAMETER -- SHUTDOWN TIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- RELIABILITY
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- MAINT. AND OPER.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
YES
DO YOU WANT THE PARAMETER TO BE ABOVE, BELOW
OR IN BETWEEN THE SPECIFIED LIMIT?
(CHOOSE 1, 2, OR 3 RESPECTIVELY)
2
MAINT. AND OPER.<5000
```

Figure 6 - Continued

```
PARAMETER -- LIFETIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- THERMAL ENERGY
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- VOLUME/SIZE
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- WEIGHT
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

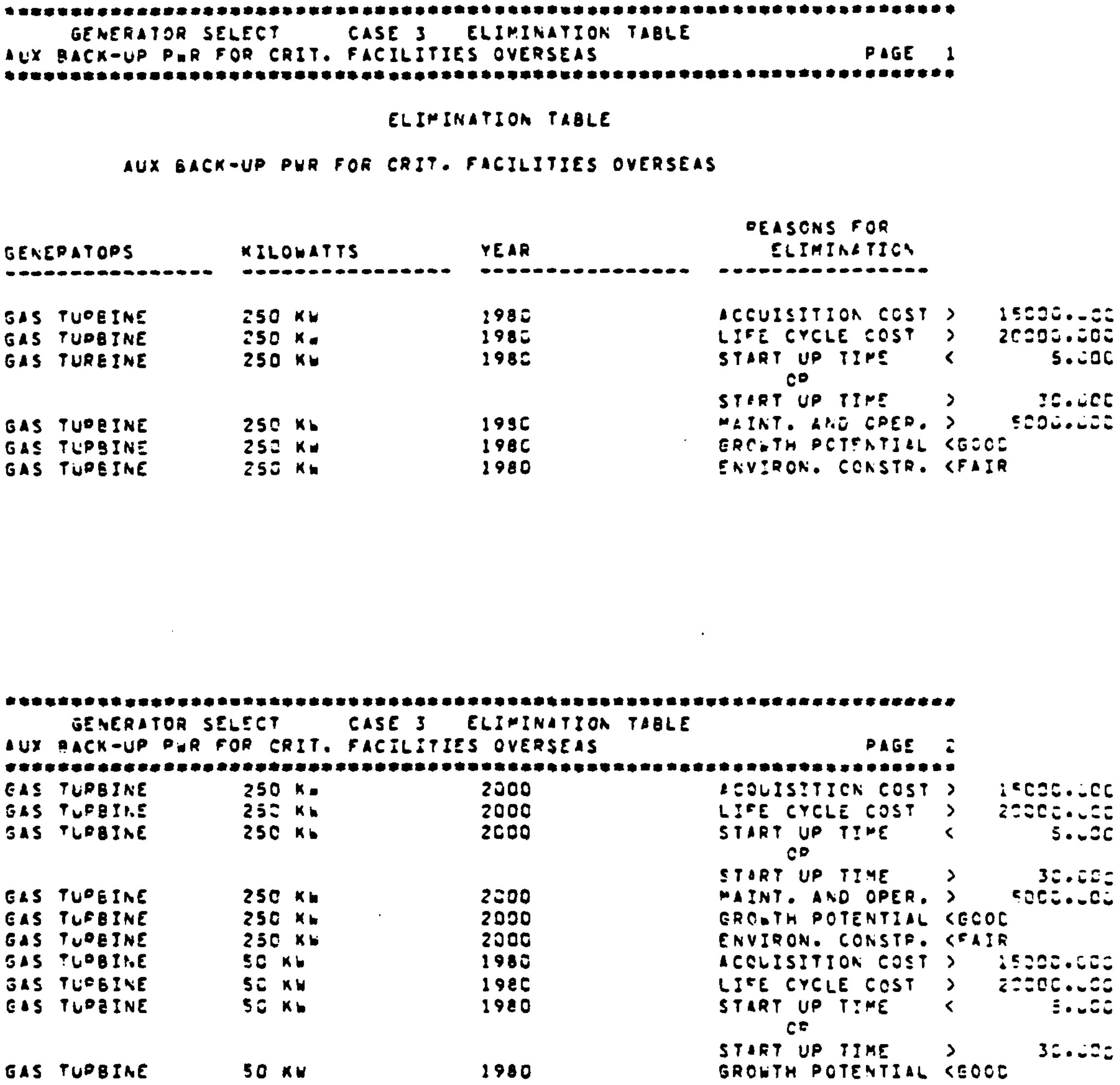
PARAMETER -- FUEL USED
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- GROWTH POTENTIAL
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
YES
THIS PARAMETER CAN BE RATED AS EXCELLENT,GOOD,FAIR,POOR, OR VERY POOR,
CHOOSE 1,2,3,4,OR,5,RESP.,
2




PARAMETER -- ENVIRON. CONSTR.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
YES
THIS PARAMETER CAN BE RATED AS EXCELLENT,GOOD,FAIR,POOR, OR VERY POOR,
CHOOSE 1,2,3,4,OR,5,RESP.,
2
```

Figure 6 - Continued



```
**********************************************************************
     GENERATOR SELECT      CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                    PAGE  1
**********************************************************************

                              ELIMINATION TABLE

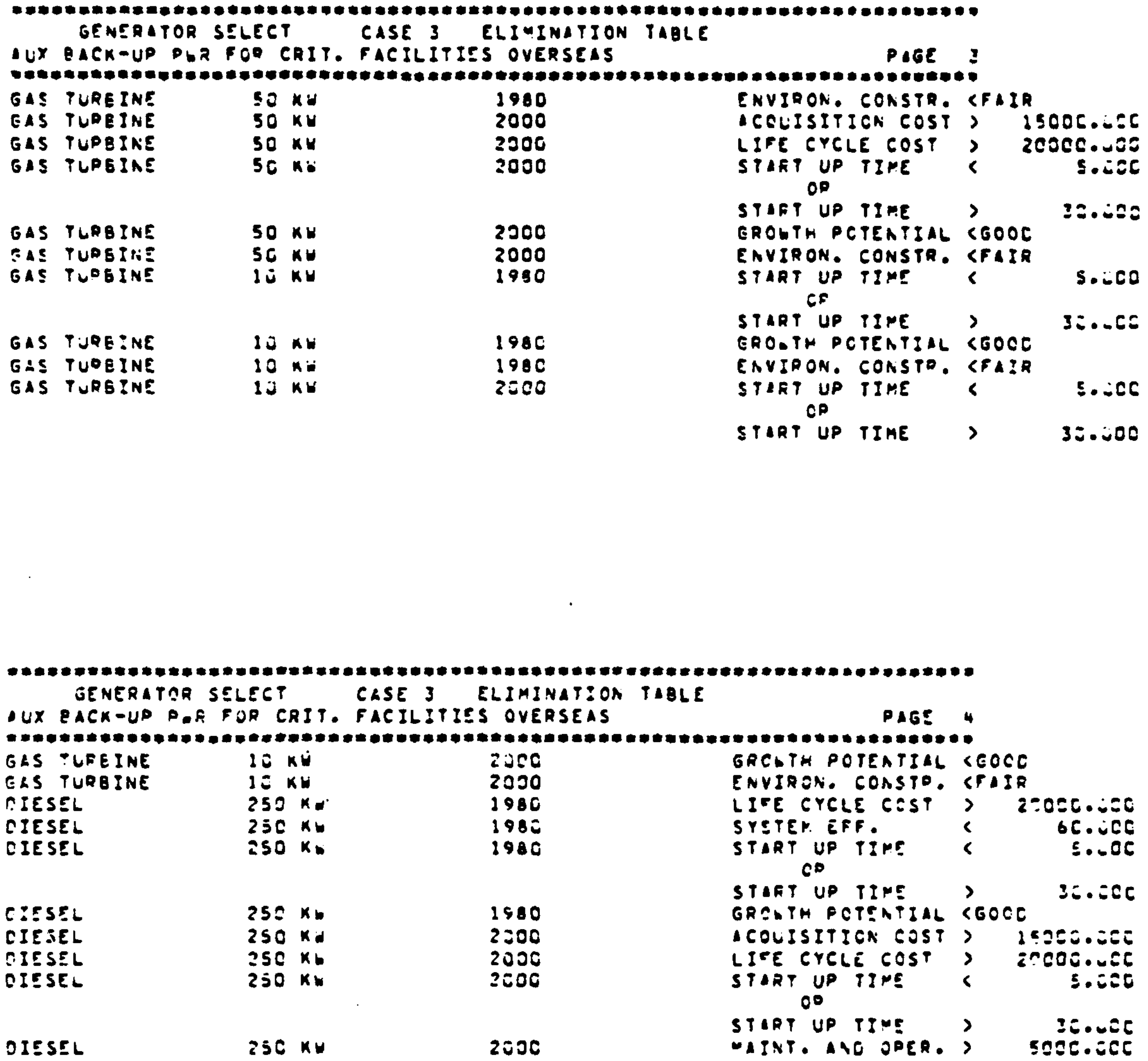
         AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS


                                                         REASONS FOR
GENERATORS          KILOWATTS          YEAR               ELIMINATION
----------------    ----------------   ----------------   ----------------

GAS TURBINE         250 KW             1980               ACQUISITION COST >    15000.000
GAS TURBINE         250 KW             1980               LIFE CYCLE COST  >    20000.000
GAS TURBINE         250 KW             1980               START UP TIME    <        5.000
                                                                OR
                                                          START UP TIME    >       30.000
GAS TURBINE         250 KW             1980               MAINT. AND OPER. >     5000.000
GAS TURBINE         250 KW             1980               GROWTH POTENTIAL <GOOD
GAS TURBINE         250 KW             1980               ENVIRON. CONSTR. <FAIR
```

```
**********************************************************************
     GENERATOR SELECT      CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                    PAGE  2
**********************************************************************
GAS TURBINE         250 KW             2000               ACQUISITION COST >    15000.000
GAS TURBINE         250 KW             2000               LIFE CYCLE COST  >    20000.000
GAS TURBINE         250 KW             2000               START UP TIME    <        5.000
                                                                OR
                                                          START UP TIME    >       30.000
GAS TURBINE         250 KW             2000               MAINT. AND OPER. >     5000.000
GAS TURBINE         250 KW             2000               GROWTH POTENTIAL <GOOD
GAS TURBINE         250 KW             2000               ENVIRON. CONSTR. <FAIR
GAS TURBINE         50 KW              1980               ACQUISITION COST >    15000.000
GAS TURBINE         50 KW              1980               LIFE CYCLE COST  >    20000.000
GAS TURBINE         50 KW              1980               START UP TIME    <        5.000
                                                                OR
                                                          START UP TIME    >       30.000
GAS TURBINE         50 KW              1980               GROWTH POTENTIAL <GOOD
```

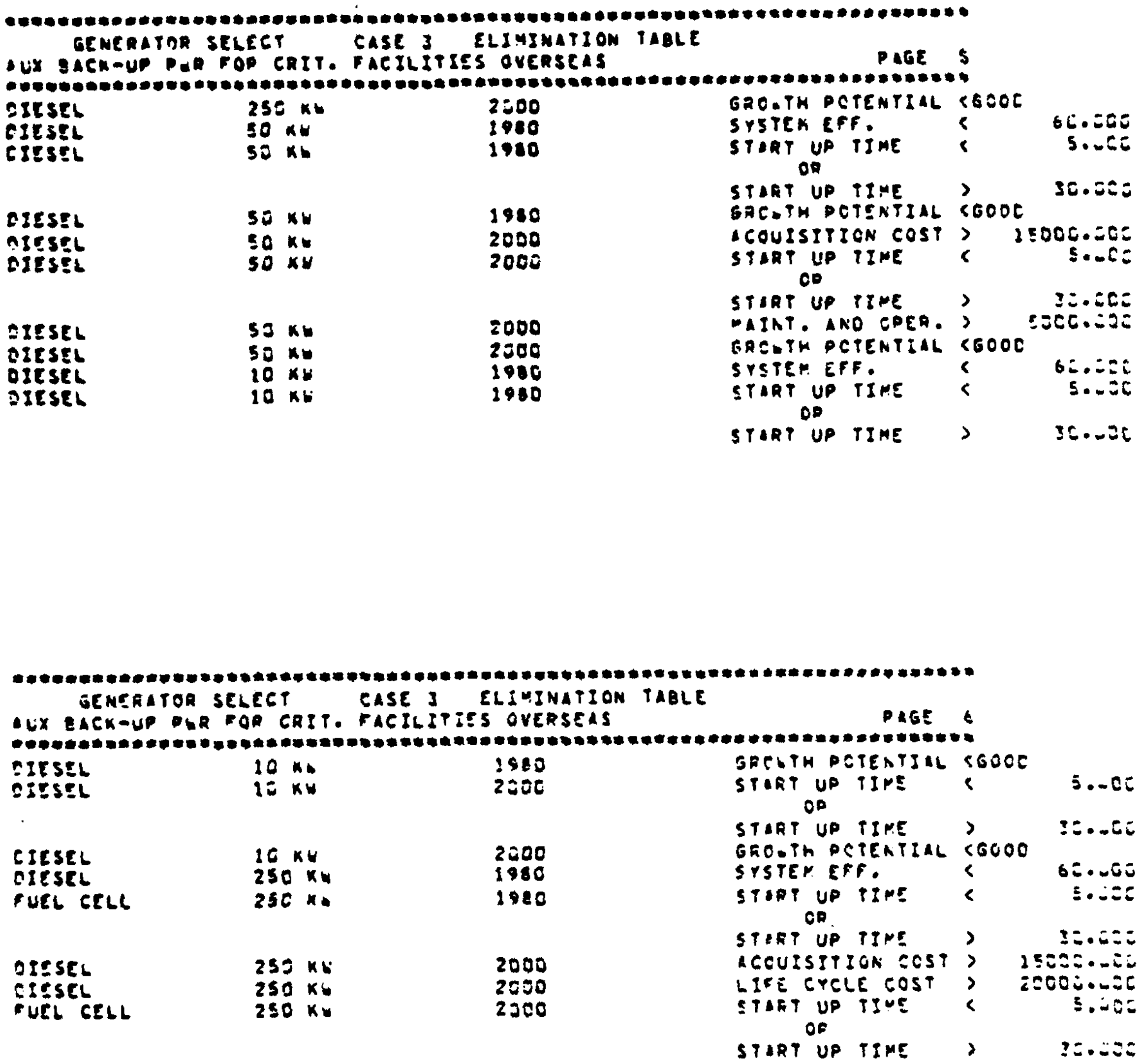
Figure 6 - Continued



```
*********************************************************************
      GENERATOR SELECT      CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                   PAGE  3
*********************************************************************
GAS TURBINE        50 KW             1980               ENVIRON. CONSTR. <FAIR
GAS TURBINE        50 KW             2000               ACQUISITION COST >   15000.000
GAS TURBINE        50 KW             2000               LIFE CYCLE COST  >   20000.000
GAS TURBINE        50 KW             2000               START UP TIME    <       5.000
                                                              OR
                                                        START UP TIME    >      30.000
GAS TURBINE        50 KW             2000               GROWTH POTENTIAL <GOOD
GAS TURBINE        50 KW             2000               ENVIRON. CONSTR. <FAIR
GAS TURBINE        10 KW             1980               START UP TIME    <       5.000
                                                              OR
                                                        START UP TIME    >      30.000
GAS TURBINE        10 KW             1980               GROWTH POTENTIAL <GOOD
GAS TURBINE        10 KW             1980               ENVIRON. CONSTR. <FAIR
GAS TURBINE        10 KW             2000               START UP TIME    <       5.000
                                                              OR
                                                        START UP TIME    >      30.000
```

```
*********************************************************************
      GENERATOR SELECT      CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                   PAGE  4
*********************************************************************
GAS TURBINE        10 KW             2000               GROWTH POTENTIAL <GOOD
GAS TURBINE        10 KW             2000               ENVIRON. CONSTR. <FAIR
DIESEL             250 KW            1980               LIFE CYCLE COST  >   20000.000
DIESEL             250 KW            1980               SYSTEM EFF.      <      60.000
DIESEL             250 KW            1980               START UP TIME    <       5.000
                                                              OR
                                                        START UP TIME    >      30.000
DIESEL             250 KW            1980               GROWTH POTENTIAL <GOOD
DIESEL             250 KW            2000               ACQUISITION COST >   15000.000
DIESEL             250 KW            2000               LIFE CYCLE COST  >   20000.000
DIESEL             250 KW            2000               START UP TIME    <       5.000
                                                              OR
                                                        START UP TIME    >      30.000
DIESEL             250 KW            2000               MAINT. AND OPER. >    5000.000
```

Figure 6 - Continued



```
*****************************************************************************
     GENERATOR SELECT      CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                       PAGE  5
*****************************************************************************
DIESEL             250 KW             2000              GROWTH POTENTIAL <GOOD
DIESEL              50 KW             1980              SYSTEM EFF.      <        60.000
DIESEL              50 KW             1980              START UP TIME    <         5.000
                                                              OR
                                                        START UP TIME    >        30.000
DIESEL              50 KW             1980              GROWTH POTENTIAL <GOOD
DIESEL              50 KW             2000              ACQUISITION COST >     15000.000
DIESEL              50 KW             2000              START UP TIME    <         5.000
                                                              OR
                                                        START UP TIME    >        30.000
DIESEL              50 KW             2000              MAINT. AND OPER. >      5000.000
DIESEL              50 KW             2000              GROWTH POTENTIAL <GOOD
DIESEL              10 KW             1980              SYSTEM EFF.      <        60.000
DIESEL              10 KW             1980              START UP TIME    <         5.000
                                                              OR
                                                        START UP TIME    >        30.000
```

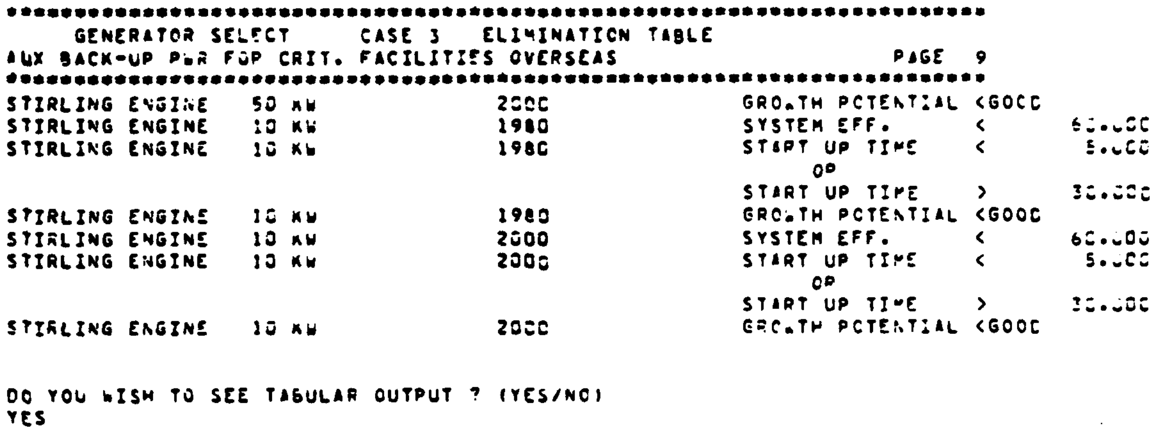
```
*****************************************************************************
     GENERATOR SELECT      CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                       PAGE  6
*****************************************************************************
DIESEL              10 KW             1980              GROWTH POTENTIAL <GOOD
DIESEL              10 KW             2000              START UP TIME    <         5.000
                                                              OR
                                                        START UP TIME    >        30.000
DIESEL              10 KW             2000              GROWTH POTENTIAL <GOOD
DIESEL             250 KW             1980              SYSTEM EFF.      <        60.000
FUEL CELL          250 KW             1980              START UP TIME    <         5.000
                                                              OR
                                                        START UP TIME    >        30.000
DIESEL             250 KW             2000              ACQUISITION COST >     15000.000
DIESEL             250 KW             2000              LIFE CYCLE COST  >     20000.000
FUEL CELL          250 KW             2000              START UP TIME    <         5.000
                                                              OR
                                                        START UP TIME    >        30.000
```

Figure 6 - Continued

```
************************************************************************
     GENERATOR SELECT     CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                   PAGE  7
************************************************************************
DIESEL           250 KW            2000             MAINT. AND OPER. >    5000.000
DIESEL           50 KW             1980             SYSTEM EFF.      <      60.000
FUEL CELL        50 KW             1980             START UP TIME    <       5.000
                                                         OR
                                                    START UP TIME    >      30.000
DIESEL           50 KW             2000             ACQUISITION COST >   15000.000
DIESEL           10 KW             1980             ACQUISITION COST >   15000.000
STIRLING ENGINE  250 KW            1980             SYSTEM EFF.      <      60.000
STIRLING ENGINE  250 KW            1980             START UP TIME    <       5.000
                                                         OR
                                                    START UP TIME    >      30.000
STIRLING ENGINE  250 KW            1980             GROWTH POTENTIAL <GOOD
STIRLING ENGINE  250 KW            2000             ACQUISITION COST >   15000.000
STIRLING ENGINE  250 KW            2000             LIFE CYCLE COST  >   20000.000
```

```
************************************************************************
     GENERATOR SELECT     CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                   PAGE  8
************************************************************************
STIRLING ENGINE  250 KW            2000             START UP TIME    <       5.000
                                                         OR
                                                    START UP TIME    >      30.000
STIRLING ENGINE  250 KW            2000             GROWTH POTENTIAL <GOOD
STIRLING ENGINE  50 KW             1980             SYSTEM EFF.      <      60.000
STIRLING ENGINE  50 KW             1980             START UP TIME    <       5.000
                                                         OR
                                                    START UP TIME    >      30.000
STIRLING ENGINE  50 KW             1980             GROWTH POTENTIAL <GOOD
STIRLING ENGINE  50 KW             2000             ACQUISITION COST >   15000.000
STIRLING ENGINE  50 KW             2000             SYSTEM EFF.      <      60.000
STIRLING ENGINE  50 KW             2000             START UP TIME    <       5.000
                                                         OR
                                                    START UP TIME    >      30.000
```

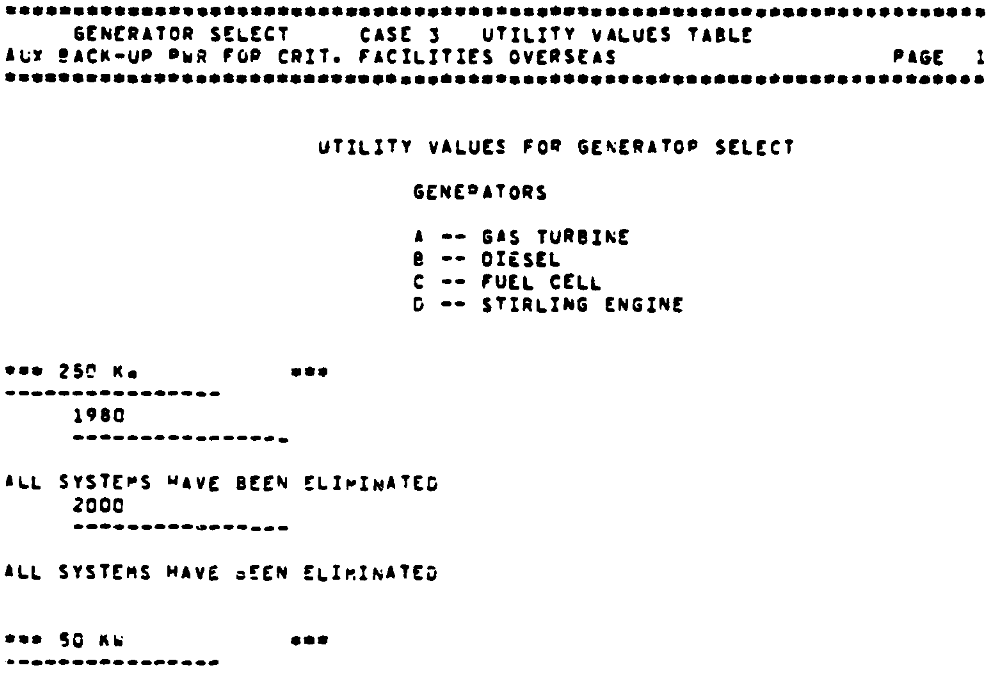
Figure 6 - Continued



```
****************************************************************
     GENERATOR SELECT     CASE 3   ELIMINATION TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS               PAGE  9
****************************************************************
STIRLING ENGINE   50 KW              2000               GROWTH POTENTIAL <GOOD
STIRLING ENGINE   10 KW              1980               SYSTEM EFF.      <      60.000
STIRLING ENGINE   10 KW              1980               START UP TIME    <       5.000
                                                             OR
                                                        START UP TIME    >      30.000
STIRLING ENGINE   10 KW              1980               GROWTH POTENTIAL <GOOD
STIRLING ENGINE   10 KW              2000               SYSTEM EFF.      <      60.000
STIRLING ENGINE   10 KW              2000               START UP TIME    <       5.000
                                                             OR
                                                        START UP TIME    >      30.000
STIRLING ENGINE   10 KW              2000               GROWTH POTENTIAL <GOOD

DO YOU WISH TO SEE TABULAR OUTPUT ? (YES/NO)
YES
```

Figure 6 - Continued



```
*************************************************************************
     GENERATOR SELECT      CASE 3   UTILITY VALUES TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                    PAGE  1
*************************************************************************

                             UTILITY VALUES FOR GENERATOR SELECT

                                     GENERATORS

                                     A -- GAS TURBINE
                                     B -- DIESEL
                                     C -- FUEL CELL
                                     D -- STIRLING ENGINE

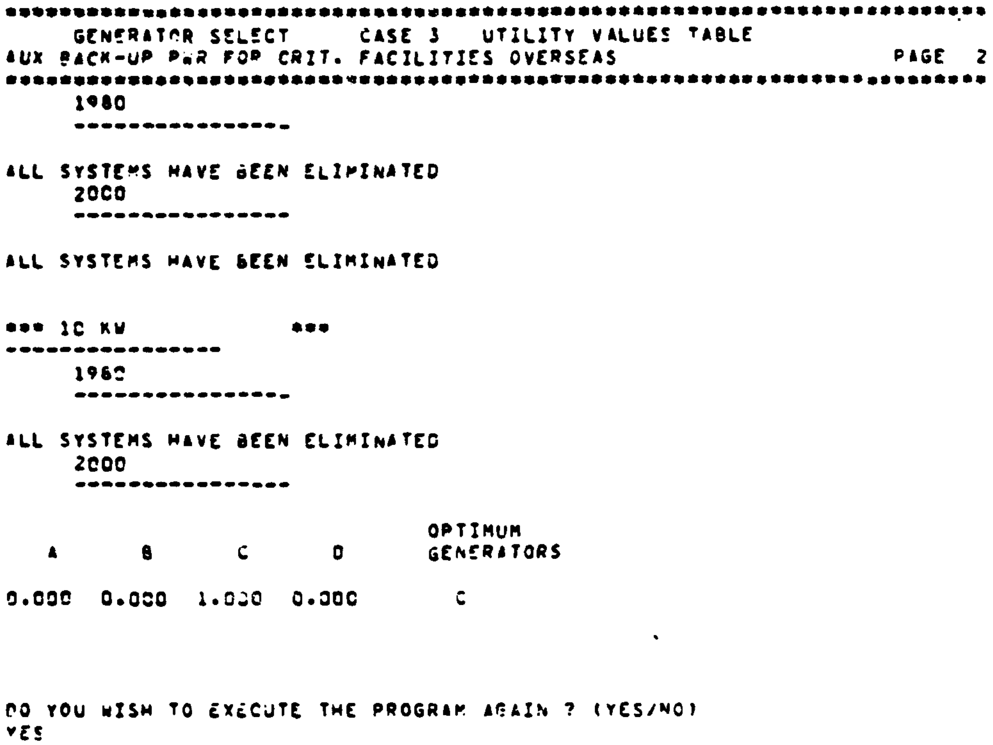
*** 250 KW           ***
----------------
     1980
     ----------------

ALL SYSTEMS HAVE BEEN ELIMINATED
     2000
     ----------------

ALL SYSTEMS HAVE BEEN ELIMINATED


*** 50 KW            ***
----------------
```

Figure 6 - Continued



```
**********************************************************************
     GENERATOR SELECT      CASE 3   UTILITY VALUES TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                   PAGE  2
**********************************************************************
     1980
     ----------------

ALL SYSTEMS HAVE BEEN ELIMINATED
     2000
     ----------------

ALL SYSTEMS HAVE BEEN ELIMINATED


*** 10 KW           ***
----------------
     1980
     ----------------

ALL SYSTEMS HAVE BEEN ELIMINATED
     2000
     ----------------

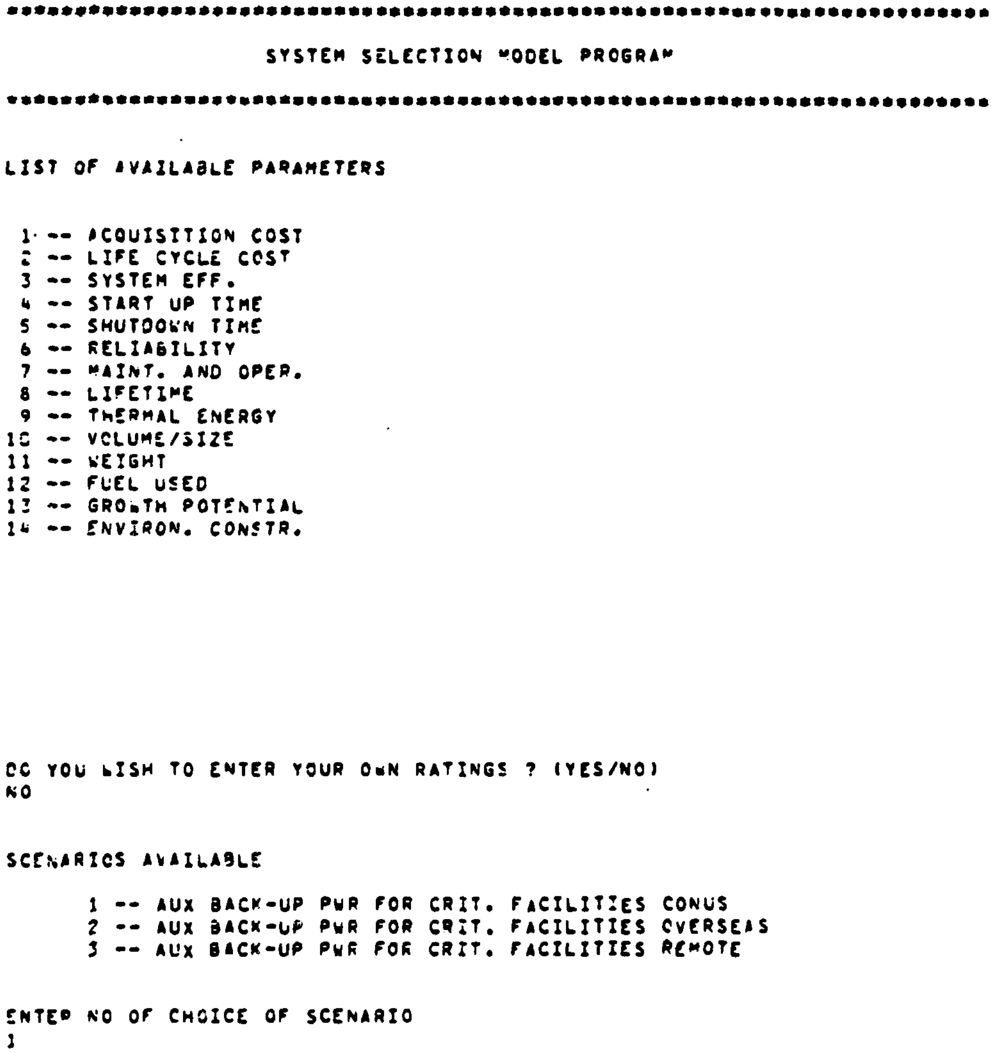
                                          OPTIMUM
   A       B       C       D             GENERATORS

0.000   0.000   1.000   0.000               C



DO YOU WISH TO EXECUTE THE PROGRAM AGAIN ? (YES/NO)
YES
```

Figure 6 - Continued



```
**********************************************************************

                    SYSTEM SELECTION MODEL PROGRAM

**********************************************************************


LIST OF AVAILABLE PARAMETERS


 1 -- ACQUISITION COST
 2 -- LIFE CYCLE COST
 3 -- SYSTEM EFF.
 4 -- START UP TIME
 5 -- SHUTDOWN TIME
 6 -- RELIABILITY
 7 -- MAINT. AND OPER.
 8 -- LIFETIME
 9 -- THERMAL ENERGY
10 -- VOLUME/SIZE
11 -- WEIGHT
12 -- FUEL USED
13 -- GROWTH POTENTIAL
14 -- ENVIRON. CONSTR.








DO YOU WISH TO ENTER YOUR OWN RATINGS ? (YES/NO)
NO


SCENARIOS AVAILABLE

      1 -- AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS
      2 -- AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS
      3 -- AUX BACK-UP PWR FOR CRIT. FACILITIES REMOTE


ENTER NO OF CHOICE OF SCENARIO
1
```

Figure 6 - Continued

```
                    AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS

                        ************************************
                        *        PARAMETERS        * RATINGS *
                        ************************************
                        *     ACQUISITION COST     *   .890  *
                        *     LIFE CYCLE COST      *   .700  *
                        *     SYSTEM EFF.          *   .650  *
                        *     START UP TIME        *   .500  *
                        *     SHUTDOWN TIME        *   .560  *
                        *     RELIABILITY          *   .750  *
                        *     MAINT. AND OPER.     *   .560  *
                        *     LIFETIME             *   .450  *
                        *     THERMAL ENERGY       *   .200  *
                        *     VOLUME/SIZE          *   .300  *
                        *     WEIGHT               *   .300  *
                        *     FUEL USED            *   .800  *
                        *     GROWTH POTENTIAL     *   .200  *
                        *     ENVIRON. CONSTR.     *   .300  *
                        ************************************

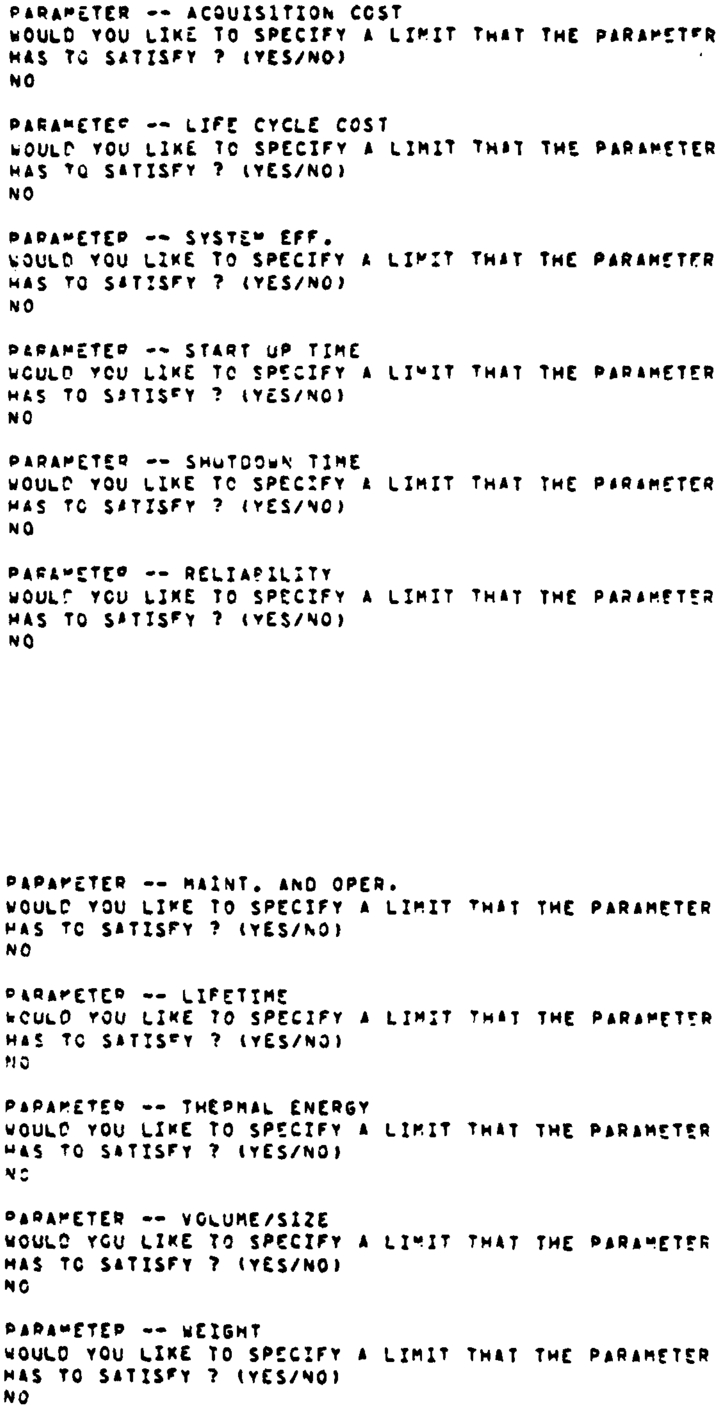



ENTER THE NUMBER OF PARAMETERS TO BE INCLUDED IN THE DECISION PROCESS


ENTER EACH INTEGER NO. ASSOCIATED WITH EACH CHOSEN
PARAMETER (FROM LOWEST TO HIGHEST)

 PARAMETER NO. --1
 PARAMETER NO. --2
 PARAMETER NO. --3
 PARAMETER NO. --4
 PARAMETER NO. --5
 PARAMETER NO. --6
 PARAMETER NO. --7
 PARAMETER NO. --8
 PARAMETER NO. --9
 PARAMETER NO. --10
 PARAMETER NO. --11
 PARAMETER NO. --12
 PARAMETER NO. --13
 PARAMETER NO. --14
```

Figure 6 - Continued



```
PARAMETER -- ACQUISITION COST
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- LIFE CYCLE COST
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- SYSTEM EFF.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- START UP TIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- SHUTDOWN TIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- RELIABILITY
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO




PARAMETER -- MAINT. AND OPER.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

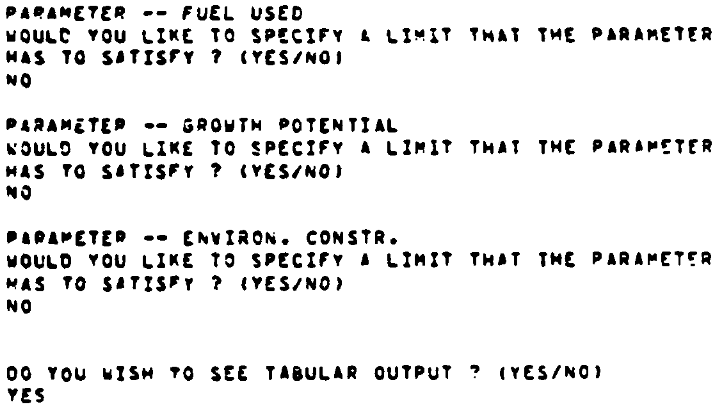
PARAMETER -- LIFETIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- THERMAL ENERGY
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- VOLUME/SIZE
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- WEIGHT
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO
```

Figure 6 - Continued



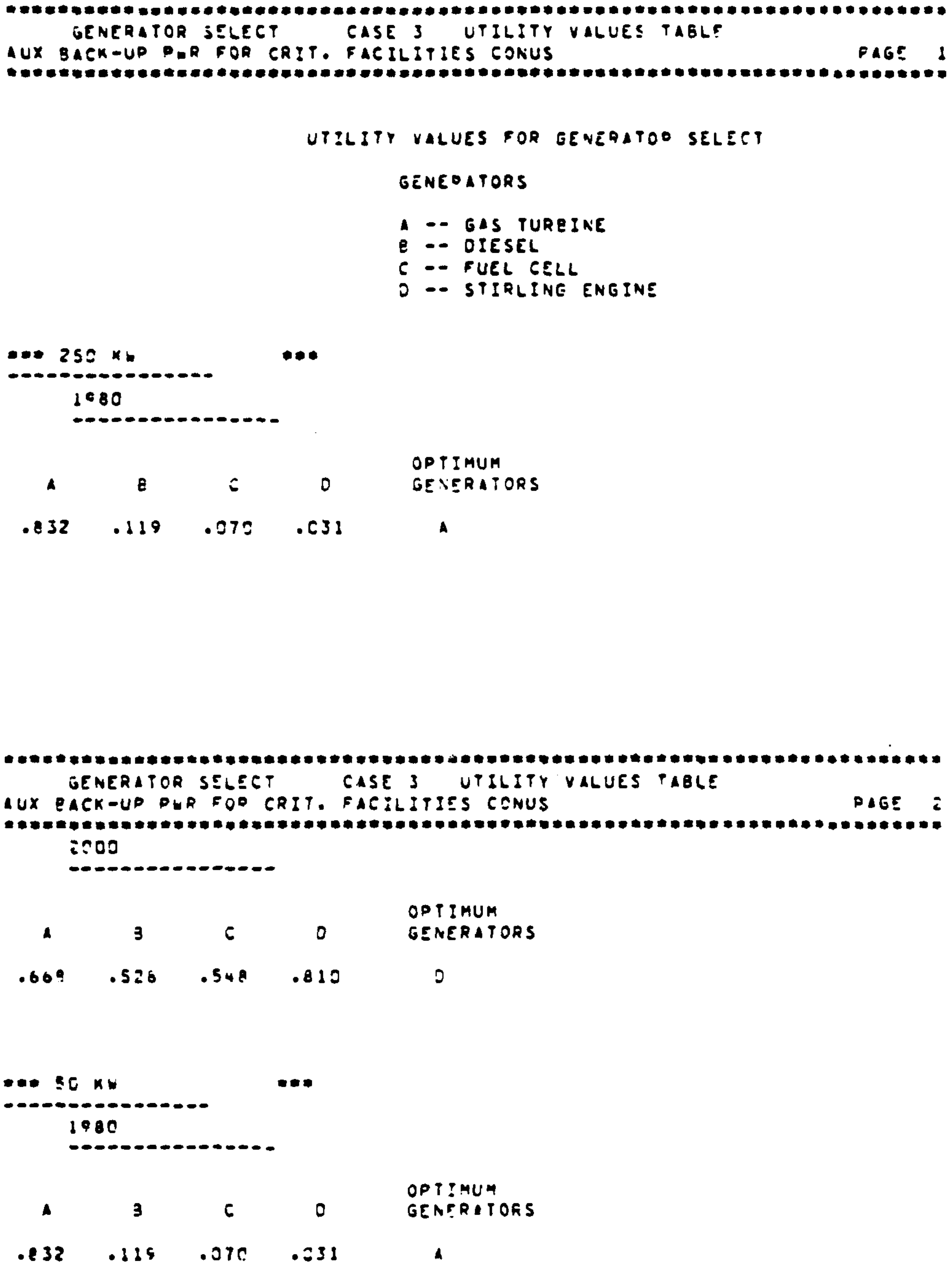
```
PARAMETER -- FUEL USED
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- GROWTH POTENTIAL
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- ENVIRON. CONSTR.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO


DO YOU WISH TO SEE TABULAR OUTPUT ? (YES/NO)
YES
```

Figure 6 - Continued



```
*****************************************************************************
     GENERATOR SELECT      CASE 3    UTILITY VALUES TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS                          PAGE  1
*****************************************************************************

                          UTILITY VALUES FOR GENERATOP SELECT

                                  GENEPATORS

                                  A -- GAS TURBINE
                                  B -- DIESEL
                                  C -- FUEL CELL
                                  D -- STIRLING ENGINE

*** 250 KW          ***
----------------
     1980
     ----------------

                                   OPTIMUM
   A       B       C       D       GENERATORS

 .832    .119    .070    .031          A




*****************************************************************************
     GENERATOR SELECT      CASE 3    UTILITY VALUES TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS                          PAGE  2
*****************************************************************************
     2000
     ----------------

                                   OPTIMUM
   A       B       C       D       GENERATORS

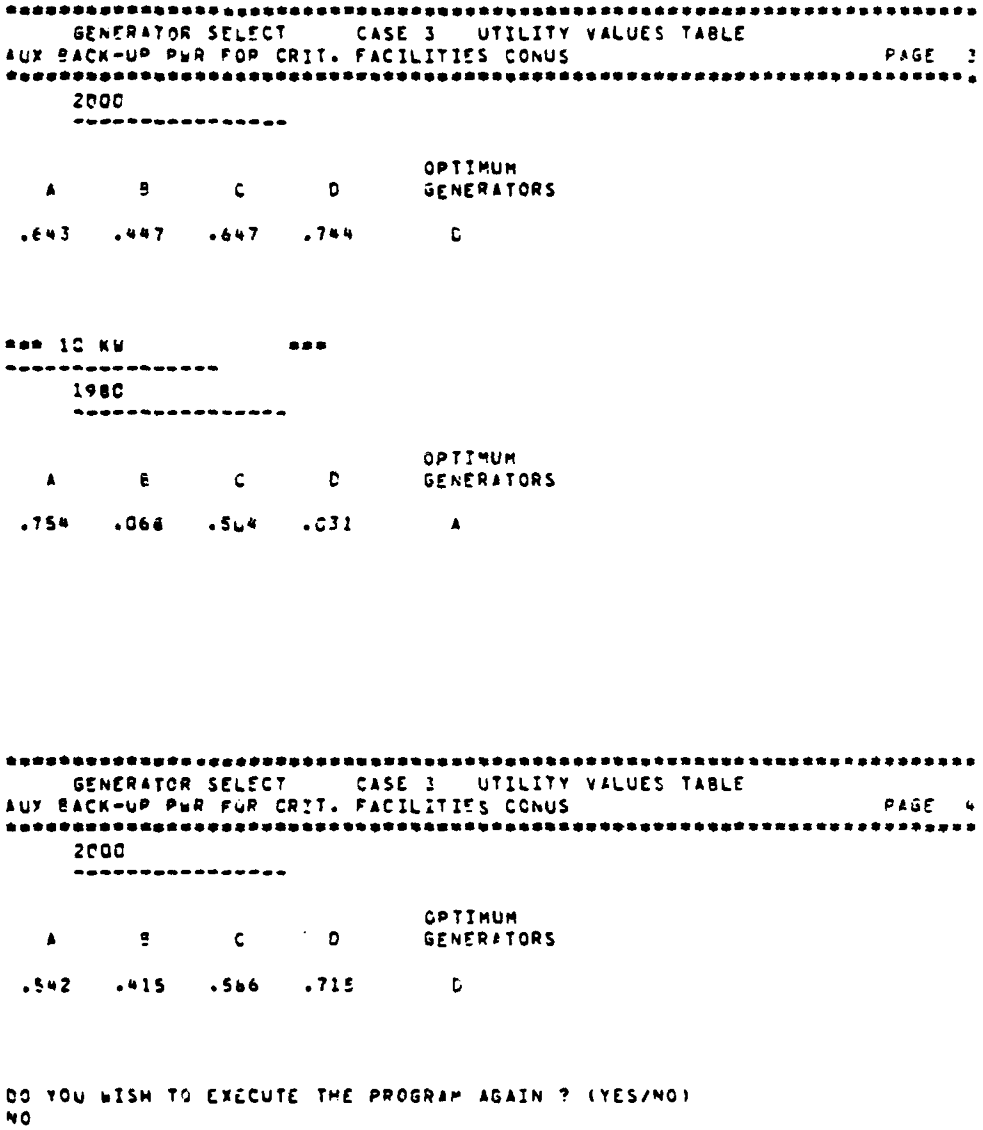
 .669    .526    .548    .810          D


*** 50 KW           ***
----------------
     1980
     ----------------

                                   OPTIMUM
   A       B       C       D       GENERATORS

 .832    .119    .070    .031          A
```

Figure 6 - Continued



```
***********************************************************************
     GENERATOR SELECT      CASE 3    UTILITY VALUES TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS                     PAGE  3
***********************************************************************
     2000
     ----------------


                                         OPTIMUM
  A       B       C       D              GENERATORS

 .643    .447    .647    .744              D



*** 10 KW              ***
----------------
     1980
     ----------------


                                         OPTIMUM
  A       B       C       D              GENERATORS

 .754    .066    .564    .031              A








***********************************************************************
     GENERATOR SELECT      CASE 3    UTILITY VALUES TABLE
AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS                     PAGE  4
***********************************************************************
     2000
     ----------------


                                         OPTIMUM
  A       B       C       D              GENERATORS

 .542    .415    .566    .715              D



DO YOU WISH TO EXECUTE THE PROGRAM AGAIN ? (YES/NO)
NO
```

Figure 6 - Concluded

b. Output

(1) Parameter package program (PPΓ)

Using the command LIST, the program will print out a listing of parameter data for each system and subsystem. See Figure 7 for an example of output of the generator selection problem.

(2) User's preference package program (UPPP)

Using the command LIST, the program will print out a listing of parameter rating values for each scenario plus the average parameter rating for each parameter. See Figure 8 for an example of output of the generator selection problem.

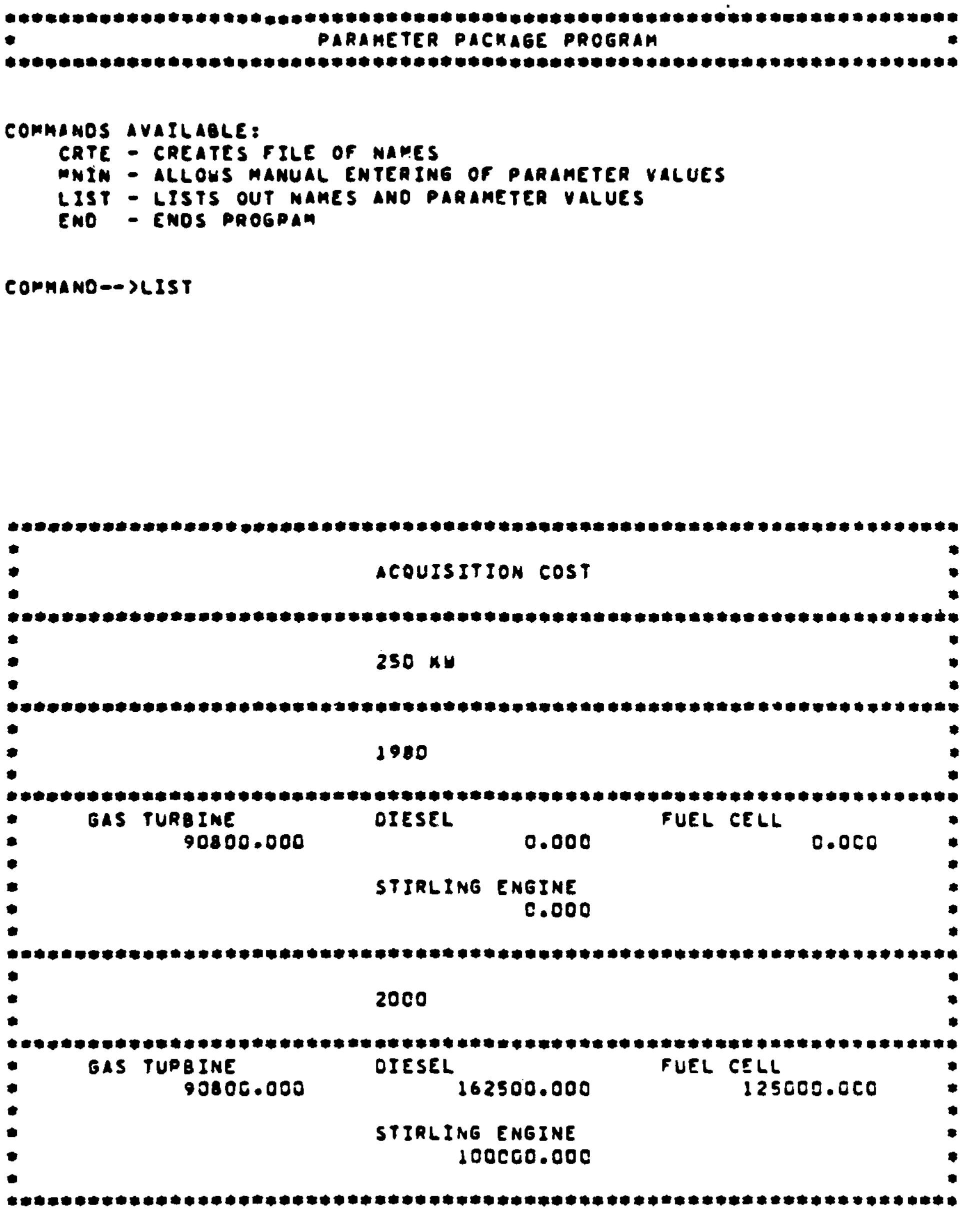
(3) System selection model program (SSMP)

This program will print out:

(a) Elimination table: if the parameter limits eliminate data for some system or subsystem, an elimination table is printed. This table prints out the eliminated system and/or subsystem and the reason why it was eliminated.

(b) Utility value table: the program prints out a table showing the relative values of each system. The highest value indicates which system is the best or optimal system. Care has to be taken when specifying limits on the parameter, or all of the systems will be eliminated. If this condition occurs, the program will print out a message so indicating.

(c) Graphics: the graphs show the same information as the utility value table. The graphics plot the system value for each system. See Figure 9 for examples of output using the generator selection problem.



```
***********************************************************************
*                       PARAMETER PACKAGE PROGRAM                    *
***********************************************************************


COMMANDS AVAILABLE:
    CRTE - CREATES FILE OF NAMES
    MNIN - ALLOWS MANUAL ENTERING OF PARAMETER VALUES
    LIST - LISTS OUT NAMES AND PARAMETER VALUES
    END  - ENDS PROGPAM

COMMAND-->LIST






***********************************************************************
*                                                                     *
*                         ACQUISITION COST                            *
*                                                                     *
***********************************************************************
*                                                                     *
*                         250 KW                                      *
*                                                                     *
***********************************************************************
*                                                                     *
*                         1980                                        *
*                                                                     *
***********************************************************************
*     GAS TURBINE         DIESEL                FUEL CELL             *
*            90800.000               0.000                   0.000    *
*                                                                     *
*                         STIRLING ENGINE                             *
*                                    0.000                            *
*                                                                     *
***********************************************************************
*                                                                     *
*                         2000                                        *
*                                                                     *
***********************************************************************
*     GAS TUPBINE         DIESEL                FUEL CELL             *
*            90800.000          162500.000              125000.000    *
*                                                                     *
*                         STIRLING ENGINE                             *
*                               100000.000                            *
*                                                                     *
***********************************************************************
```

Figure 7 - Parameter Package Program Output

```
*****************************************************************
*                                                               *
*                          50 KW                                *
*                                                               *
*****************************************************************
*                                                               *
*                          1980                                 *
*                                                               *
*****************************************************************
*    GAS TURBINE           DIESEL                 FUEL CELL     *
*           20600.000              0.000                0.000   *
*                                                               *
*                          STIRLING ENGINE                      *
*                                  0.000                        *
*                                                               *
*****************************************************************
*                                                               *
*                          2000                                 *
*                                                               *
*****************************************************************
*    GAS TURBINE           DIESEL                 FUEL CELL     *
*           20600.000          35000.000            25000.000   *
*                                                               *
*                          STIRLING ENGINE                      *
*                                  22500.000                    *
*                                                               *
*****************************************************************
```

```
*****************************************************************
*                                                               *
*                          10 KW                                *
*                                                               *
*****************************************************************
*                                                               *
*                          1980                                 *
*                                                               *
*****************************************************************
*    GAS TURBINE           DIESEL                 FUEL CELL     *
*            6800.000              0.000            20000.000   *
*                                                               *
*                          STIRLING ENGINE                      *
*                                  0.000                        *
*                                                               *
*****************************************************************
*                                                               *
*                          2000                                 *
*                                                               *
*****************************************************************
*    GAS TURBINE           DIESEL                 FUEL CELL     *
*            6800.000           8000.000             5000.000   *
*                                                               *
*                          STIRLING ENGINE                      *
*                                  3500.000                     *
*                                                               *
*****************************************************************
```

Figure 7 - Continued

```
*******************************************************************
*                                                                 *
*                         LIFE CYCLE COST                         *
*                                                                 *
*******************************************************************
*                                                                 *
*                         250 KW                                  *
*                                                                 *
*******************************************************************
*                                                                 *
*                         1980                                    *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL              FUEL CELL           *
*           120200.000           64700.000               0.000    *
*                                                                 *
*                         STIRLING ENGINE                         *
*                                    0.000                        *
*                                                                 *
*******************************************************************
*                                                                 *
*                         2000                                    *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL              FUEL CELL           *
*           114350.000           64700.000           38262.500    *
*                                                                 *
*                         STIRLING ENGINE                         *
*                                56000.000                        *
*                                                                 *
*******************************************************************
```

Figure 7 - Continued

```
*************************************************************
*                                                           *
*                       50 KW                               *
*                                                           *
*************************************************************
*                                                           *
*                       1980                                *
*                                                           *
*************************************************************
*    GAS TURBINE        DIESEL            FUEL CELL         *
*          32300.000          16100.000             0.000   *
*                                                           *
*                       STIRLING ENGINE                     *
*                                 0.000                     *
*                                                           *
*************************************************************
*                                                           *
*                       2000                                *
*                                                           *
*************************************************************
*    GAS TURBINE        DIESEL            FUEL CELL         *
*          26825.000          16100.000          7837.500   *
*                                                           *
*                       STIRLING ENGINE                     *
*                             12900.000                     *
*                                                           *
*************************************************************
```

```
*************************************************************
*                                                           *
*                       10 KW                               *
*                                                           *
*************************************************************
*                                                           *
*                       1980                                *
*                                                           *
*************************************************************
*    GAS TURBINE        DIESEL            FUEL CELL         *
*           7900.000           5500.000          2880.000   *
*                                                           *
*                       STIRLING ENGINE                     *
*                                 0.000                     *
*                                                           *
*************************************************************
*                                                           *
*                       2000                                *
*                                                           *
*************************************************************
*    GAS TURBINE        DIESEL            FUEL CELL         *
*           6475.000           5500.000          1548.750   *
*                                                           *
*                       STIRLING ENGINE                     *
*                              3810.000                     *
*                                                           *
*************************************************************
```

Figure 7 - Continued

```
*************************************************************************
*                                                                       *
*                           SYSTEM EFF.                                 *
*                                                                       *
*************************************************************************
*                                                                       *
*                           250 KW                                      *
*                                                                       *
*************************************************************************
*                                                                       *
*                           1980                                        *
*                                                                       *
*************************************************************************
*     GAS TURBINE           DIESEL                FUEL CELL             *
*                82.500                 0.000                 0.000     *
*                                                                       *
*                           STIRLING ENGINE                             *
*                                       0.000                           *
*                                                                       *
*************************************************************************
*                                                                       *
*                           2000                                        *
*                                                                       *
*************************************************************************
*     GAS TURBINE           DIESEL                FUEL CELL             *
*                72.250                63.000                60.000     *
*                                                                       *
*                           STIRLING ENGINE                             *
*                                      60.000                           *
*                                                                       *
*************************************************************************
```

Figure 7 - Continued

```
*********************************************************************
*                                                                   *
*                          50 KW                                    *
*                                                                   *
*********************************************************************
*                                                                   *
*                          1980                                     *
*                                                                   *
*********************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL          *
*              86.500                0.000                0.0C0     *
*                                                                   *
*                          STIRLING ENGINE                          *
*                                    0.000                          *
*                                                                   *
*********************************************************************
*                                                                   *
*                          2000                                     *
*                                                                   *
*********************************************************************
*     GAS TUPBINE          DIESEL                FUEL CELL          *
*              75.750               65.000               60.0CC     *
*                                                                   *
*                          STIRLING ENGINE                          *
*                                   55.00C                          *
*                                                                   *
*********************************************************************
```

```
*********************************************************************
*                                                                   *
*                          10 KW                                    *
*                                                                   *
*********************************************************************
*                                                                   *
*                          1980                                     *
*                                                                   *
*********************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL          *
*              87.500                0.000               65.0C0     *
*                                                                   *
*                          STIRLING ENGINE                          *
*                                    0.00C                          *
*                                                                   *
*********************************************************************
*                                                                   *
*                          2000                                     *
*                                                                   *
*********************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL          *
*              77.750               67.00C               60.0CC     *
*                                                                   *
*                          STIRLING ENGINE                          *
*                                   55.000                          *
*                                                                   *
*********************************************************************
```

Figure 7 - Continued

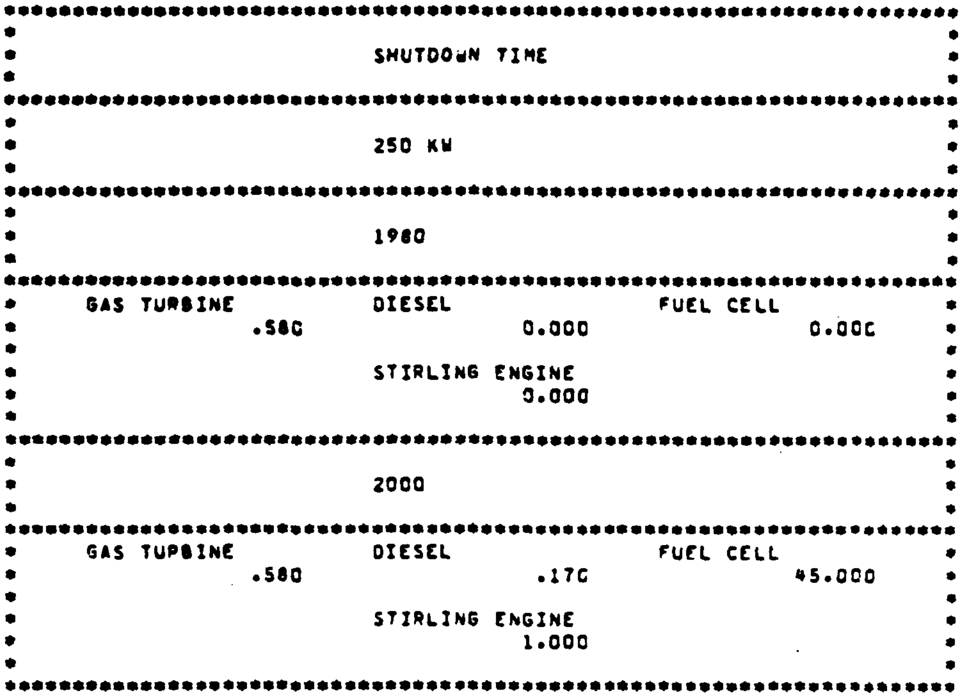
```
********************************************************************
*                                                                  *
*                         START UP TIME                            *
*                                                                  *
********************************************************************
*                                                                  *
*                         250 KW                                   *
*                                                                  *
********************************************************************
*                                                                  *
*                         1980                                     *
*                                                                  *
********************************************************************
*     GAS TURBINE         DIESEL              FUEL CELL            *
*                 .580               0.000               0.000     *
*                                                                  *
*                         STIRLING ENGINE                          *
*                                    0.000                         *
*                                                                  *
********************************************************************
*                                                                  *
*                         2000                                     *
*                                                                  *
********************************************************************
*     GAS TURBINE         DIESEL              FUEL CELL            *
*                 .580                .170              90.000     *
*                                                                  *
*                         STIRLING ENGINE                          *
*                                    1.000                         *
*                                                                  *
********************************************************************
```

Figure 7 - Continued

```
********************************************************************
*                                                                  *
*                         50 KW                                    *
*                                                                  *
********************************************************************
*                                                                  *
*                         1980                                     *
*                                                                  *
********************************************************************
*    GAS TURBINE          DIESEL              FUEL CELL            *
*               1.000               0.000               0.000      *
*                                                                  *
*                         STIRLING ENGINE                          *
*                                    0.000                         *
*                                                                  *
********************************************************************
*                                                                  *
*                         2000                                     *
*                                                                  *
********************************************************************
*    GAS TURBINE          DIESEL              FUEL CELL            *
*               1.000                .170              30.000      *
*                                                                  *
*                         STIRLING ENGINE                          *
*                                    1.000                         *
*                                                                  *
********************************************************************
```

```
********************************************************************
*                                                                  *
*                         10 KW                                    *
*                                                                  *
********************************************************************
*                                                                  *
*                         1980                                     *
*                                                                  *
********************************************************************
*    GAS TURBINE          DIESEL              FUEL CELL            *
*               1.000               0.000              15.000      *
*                                                                  *
*                         STIRLING ENGINE                          *
*                                    0.000                         *
*                                                                  *
********************************************************************
*                                                                  *
*                         2000                                     *
*                                                                  *
********************************************************************
*    GAS TURBINE          DIESEL              FUEL CELL            *
*               1.000                .170              15.000      *
*                                                                  *
*                         STIRLING ENGINE                          *
*                                    1.000                         *
*                                                                  *
********************************************************************
```

Figure 7 - Continued



```
*******************************************************************
*                                                                 *
*                        SHUTDOWN TIME                            *
*                                                                 *
*******************************************************************
*                                                                 *
*                        250 KW                                   *
*                                                                 *
*******************************************************************
*                                                                 *
*                        1980                                     *
*                                                                 *
*******************************************************************
*     GAS TURBINE        DIESEL              FUEL CELL            *
*               .580               0.000               0.000      *
*                                                                 *
*                        STIRLING ENGINE                          *
*                                  0.000                          *
*                                                                 *
*******************************************************************
*                                                                 *
*                        2000                                     *
*                                                                 *
*******************************************************************
*     GAS TURBINE        DIESEL              FUEL CELL            *
*               .580                .170              45.000      *
*                                                                 *
*                        STIRLING ENGINE                          *
*                                  1.000                          *
*                                                                 *
*******************************************************************
```

Figure 7 - Continued

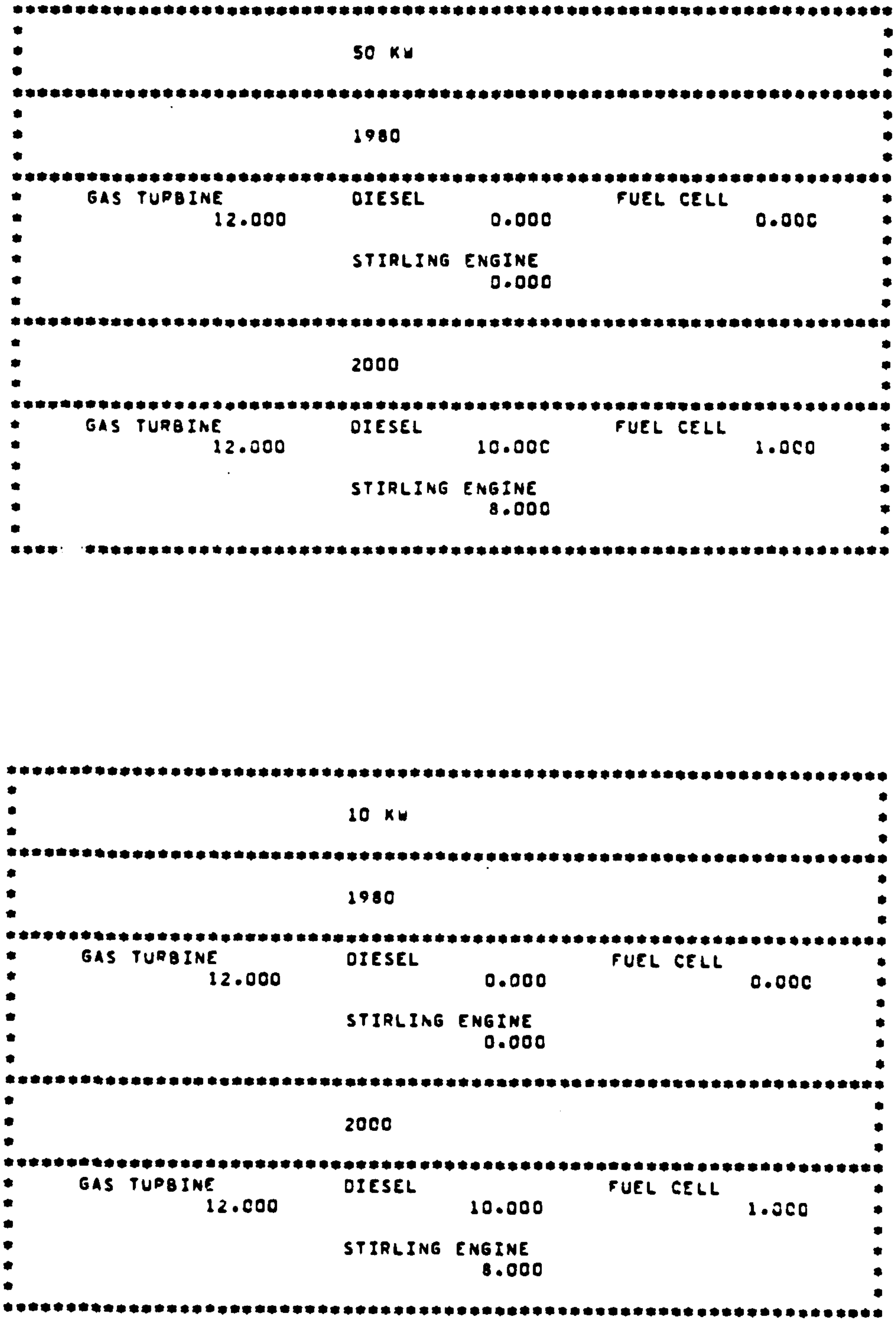
```
******************************************************************
*                                                                *
*                            50 KW                               *
*                                                                *
******************************************************************
*                                                                *
*                            1980                                *
*                                                                *
******************************************************************
*     GAS TURBINE           DIESEL                  FUEL CELL    *
*                1.000                0.000                0.000 *
*                                                                *
*                           STIRLING ENGINE                      *
*                                     0.000                      *
*                                                                *
******************************************************************
*                                                                *
*                            2000                                *
*                                                                *
******************************************************************
*     GAS TURBINE           DIESEL                  FUEL CELL    *
*                1.000                 .170               15.000 *
*                                                                *
*                           STIRLING ENGINE                      *
*                                     1.000                      *
*                                                                *
******************************************************************
```

```
******************************************************************
*                                                                *
*                            10 KW                               *
*                                                                *
******************************************************************
*                                                                *
*                            1980                                *
*                                                                *
******************************************************************
*     GAS TURBINE           DIESEL                  FUEL CELL    *
*                1.000                0.000                7.800 *
*                                                                *
*                           STIRLING ENGINE                      *
*                                     0.000                      *
*                                                                *
******************************************************************
*                                                                *
*                            2000                                *
*                                                                *
******************************************************************
*     GAS TURBINE           DIESEL                  FUEL CELL    *
*                1.000                 .170                7.800 *
*                                                                *
*                           STIRLING ENGINE                      *
*                                     1.000                      *
*                                                                *
******************************************************************
```

Figure 7 - Continued

```
**********************************************************************
*                                                                    *
*                          RELIABILITY                               *
*                                                                    *
**********************************************************************
*                                                                    *
*                          250 KW                                    *
*                                                                    *
**********************************************************************
*                                                                    *
*                          1980                                      *
*                                                                    *
**********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL            *
*               12.000               0.000                0.000      *
*                                                                    *
*                          STIRLING ENGINE                           *
*                                    0.00C                           *
*                                                                    *
**********************************************************************
*                                                                    *
*                          2000                                      *
*                                                                    *
**********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL            *
*               12.000              10.000                1.000      *
*                                                                    *
*                          STIRLING ENGINE                           *
*                                    8.000                           *
*                                                                    *
**********************************************************************
```

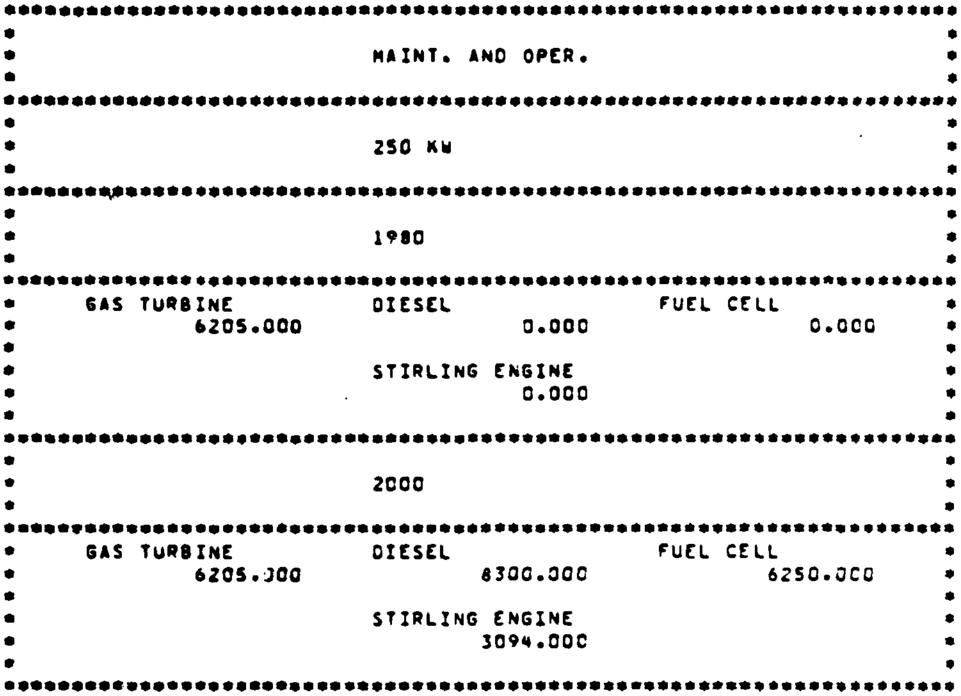
Figure 7 - Continued



```
******************************************************************
*                                                                *
*                           50 KW                                *
*                                                                *
******************************************************************
*                                                                *
*                           1980                                 *
*                                                                *
******************************************************************
*     GAS TUPBINE          DIESEL               FUEL CELL        *
*              12.000                0.000               0.00C   *
*                                                                *
*                          STIRLING ENGINE                       *
*                                    0.000                       *
*                                                                *
******************************************************************
*                                                                *
*                          2000                                  *
*                                                                *
******************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL        *
*              12.000               10.00C               1.0C0   *
*                                                                *
*                          STIRLING ENGINE                       *
*                                    8.000                       *
*                                                                *
****  ************************************************************
```

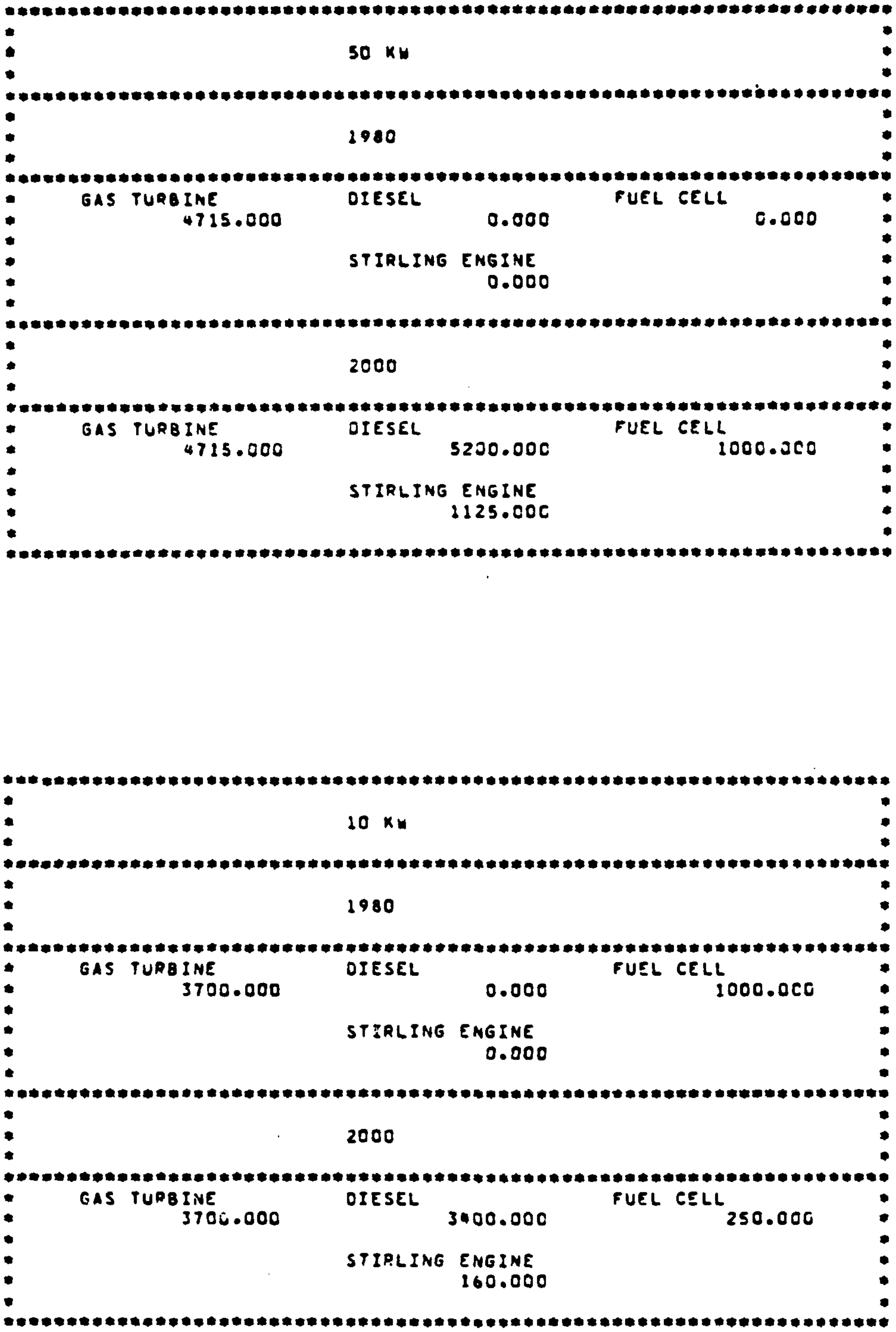
```
******************************************************************
*                                                                *
*                          10 KW                                 *
*                                                                *
******************************************************************
*                                                                *
*                          1980                                  *
*                                                                *
******************************************************************
*     GAS TUPBINE          DIESEL               FUEL CELL        *
*              12.000                0.000               0.00C   *
*                                                                *
*                          STIRLING ENGINE                       *
*                                    0.000                       *
*                                                                *
******************************************************************
*                                                                *
*                          2000                                  *
*                                                                *
******************************************************************
*     GAS TUPBINE          DIESEL               FUEL CELL        *
*              12.000               10.000               1.0C0   *
*                                                                *
*                          STIRLING ENGINE                       *
*                                    8.000                       *
*                                                                *
******************************************************************
```

Figure 7 - Continued



```
*******************************************************************
*                                                                 *
*                         MAINT. AND OPER.                        *
*                                                                 *
*******************************************************************
*                                                                 *
*                         250 KW                                  *
*                                                                 *
*******************************************************************
*                                                                 *
*                         1980                                    *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL                FUEL CELL         *
*             6205.000              0.000                 0.000   *
*                                                                 *
*                         STIRLING ENGINE                         *
*                                   0.000                         *
*                                                                 *
*******************************************************************
*                                                                 *
*                         2000                                    *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL                FUEL CELL         *
*             6205.000           8300.000              6250.000   *
*                                                                 *
*                         STIRLING ENGINE                         *
*                                3094.000                         *
*                                                                 *
*******************************************************************
```

Figure 7 - Continued



```
******************************************************************
*                                                                *
*                            50 KW                               *
*                                                                *
******************************************************************
*                                                                *
*                            1980                                *
*                                                                *
******************************************************************
*     GAS TURBINE           DIESEL                FUEL CELL      *
*             4715.000                0.000               0.000  *
*                                                                *
*                           STIRLING ENGINE                      *
*                                     0.000                      *
*                                                                *
******************************************************************
*                                                                *
*                            2000                                *
*                                                                *
******************************************************************
*     GAS TURBINE           DIESEL                FUEL CELL      *
*             4715.000             5200.000            1000.000  *
*                                                                *
*                           STIRLING ENGINE                      *
*                                  1125.000                      *
*                                                                *
******************************************************************


******************************************************************
*                                                                *
*                            10 KW                               *
*                                                                *
******************************************************************
*                                                                *
*                            1980                                *
*                                                                *
******************************************************************
*     GAS TURBINE           DIESEL                FUEL CELL      *
*             3700.000                0.000            1000.000  *
*                                                                *
*                           STIRLING ENGINE                      *
*                                     0.000                      *
*                                                                *
******************************************************************
*                                                                *
*                            2000                                *
*                                                                *
******************************************************************
*     GAS TURBINE           DIESEL                FUEL CELL      *
*             3700.000             3400.000             250.000  *
*                                                                *
*                           STIRLING ENGINE                      *
*                                   160.000                      *
*                                                                *
******************************************************************
```

Figure 7 - Continued

```
****************************************************************
*                                                              *
*                        LIFETIME                              *
*                                                              *
****************************************************************
*                                                              *
*                        250 KW                                *
*                                                              *
****************************************************************
*                                                              *
*                        1980                                  *
*                                                              *
****************************************************************
*      GAS TURBINE       DIESEL                FUEL CELL       *
*               11.000             0.000                0.000  *
*                                                              *
*                        STIRLING ENGINE                       *
*                                  0.000                       *
*                                                              *
****************************************************************
*                                                              *
*                        2000                                  *
*                                                              *
****************************************************************
*      GAS TURBINE       DIESEL                FUEL CELL       *
*               11.000            22.000                0.000  *
*                                                              *
*                        STIRLING ENGINE                       *
*                                 25.000                       *
*                                                              *
****************************************************************
```

Figure 7 - Continued

```
******************************************************************
*                                                                *
*                        50 KW                                   *
*                                                                *
******************************************************************
*                                                                *
*                        1980                                    *
*                                                                *
******************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL           *
*             11.000               0.000               0.000    *
*                                                                *
*                        STIRLING ENGINE                         *
*                                  0.000                        *
*                                                                *
******************************************************************
*                                                                *
*                        2000                                    *
*                                                                *
******************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL           *
*             11.000              13.000               0.000    *
*                                                                *
*                        STIRLING ENGINE                         *
*                                 25.000                        *
*                                                                *
******************************************************************
```

```
******************************************************************
*                                                                *
*                        10 KW                                   *
*                                                                *
******************************************************************
*                                                                *
*                        1980                                    *
*                                                                *
******************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL           *
*             11.000               0.000               0.000    *
*                                                                *
*                        STIRLING ENGINE                         *
*                                  0.000                        *
*                                                                *
******************************************************************
*                                                                *
*                        2000                                    *
*                                                                *
******************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL           *
*             11.000               9.000               0.000    *
*                                                                *
*                        STIRLING ENGINE                         *
*                                 25.000                        *
*                                                                *
******************************************************************
```

Figure 7 - Continued

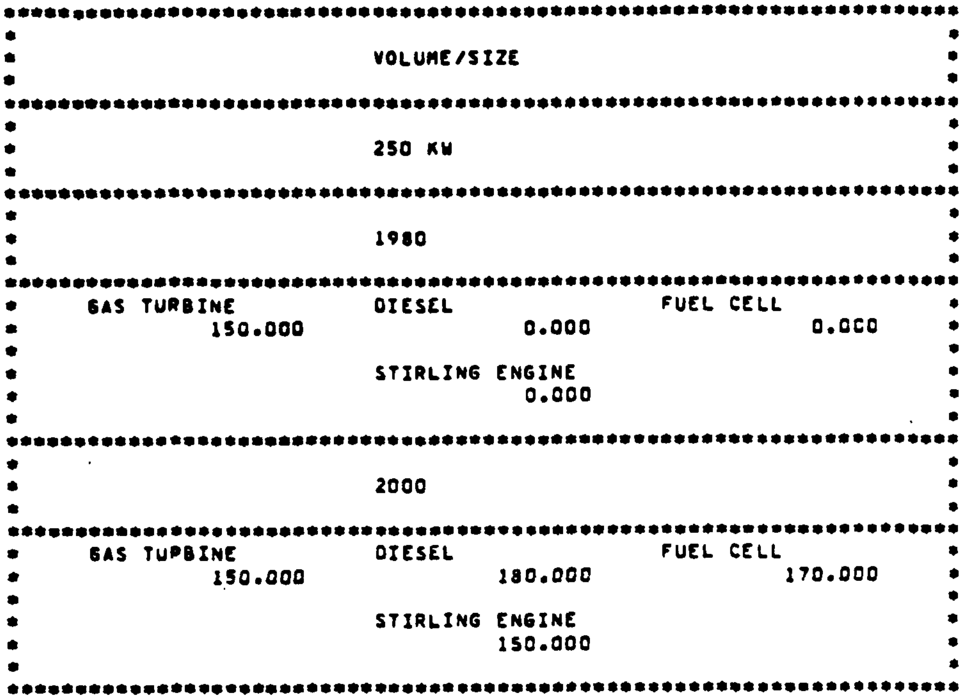
```
***********************************************************************
*                                                                     *
*                          THERMAL ENERGY                             *
*                                                                     *
***********************************************************************
*                                                                     *
*                          250 KW                                     *
*                                                                     *
***********************************************************************
*                                                                     *
*                          1980                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*                7.590                0.00C                G.000      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                     0.000                           *
*                                                                     *
***********************************************************************
*                                                                     *
*                          2000                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*                8.690                3.10C                9.200      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                     3.700                           *
*                                                                     *
***********************************************************************
```

Figure 7 - Continued

```
**********************************************************************
*                                                                    *
*                          50 KW                                     *
*                                                                    *
**********************************************************************
*                                                                    *
*                          1980                                      *
*                                                                    *
**********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL            *
*                 .340                0.000                0.000     *
*                                                                    *
*                          STIRLING ENGINE                           *
*                                     0.000                          *
*                                                                    *
**********************************************************************
*                                                                    *
*                          2000                                      *
*                                                                    *
**********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL            *
*                 .700                8.500                8.4CC     *
*                                                                    *
*                          STIRLING ENGINE                           *
*                                     8.90C                          *
*                                                                    *
**********************************************************************
```

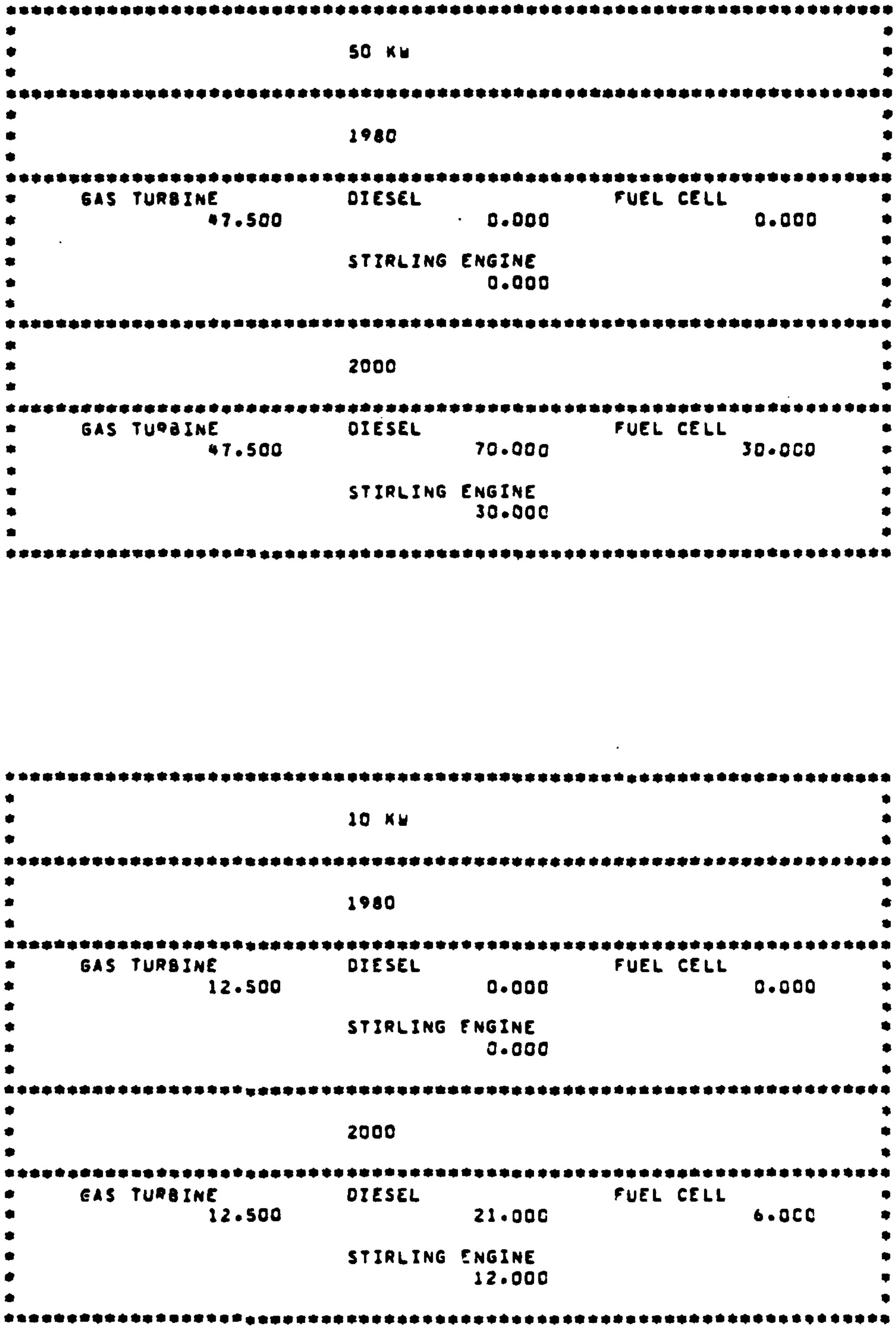
```
**********************************************************************
*                                                                    *
*                          10 KW                                     *
*                                                                    *
**********************************************************************
*                                                                    *
*                          1980                                      *
*                                                                    *
**********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL            *
*                 .860                0.000                0.0CC     *
*                                                                    *
*                          STIRLING ENGINE                           *
*                                     0.000                          *
*                                                                    *
**********************************************************************
*                                                                    *
*                          2000                                      *
*                                                                    *
**********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL            *
*                 .940                6.700                6.1C0     *
*                                                                    *
*                          STIRLING ENGINE                           *
*                                     7.80C                          *
*                                                                    *
**********************************************************************
```

Figure 7 - Continued



```
**********************************************************************
*                                                                    *
*                         VOLUME/SIZE                                *
*                                                                    *
**********************************************************************
*                                                                    *
*                         250 KW                                     *
*                                                                    *
**********************************************************************
*                                                                    *
*                         1980                                       *
*                                                                    *
**********************************************************************
*     GAS TURBINE         DIESEL                FUEL CELL            *
*              150.000             0.000                 0.000       *
*                                                                    *
*                         STIRLING ENGINE                            *
*                                  0.000                             *
*                                                                    *
**********************************************************************
*                                                                    *
*                         2000                                       *
*                                                                    *
**********************************************************************
*     GAS TURBINE         DIESEL                FUEL CELL            *
*              150.000           180.000               170.000       *
*                                                                    *
*                         STIRLING ENGINE                            *
*                                150.000                             *
*                                                                    *
**********************************************************************
```

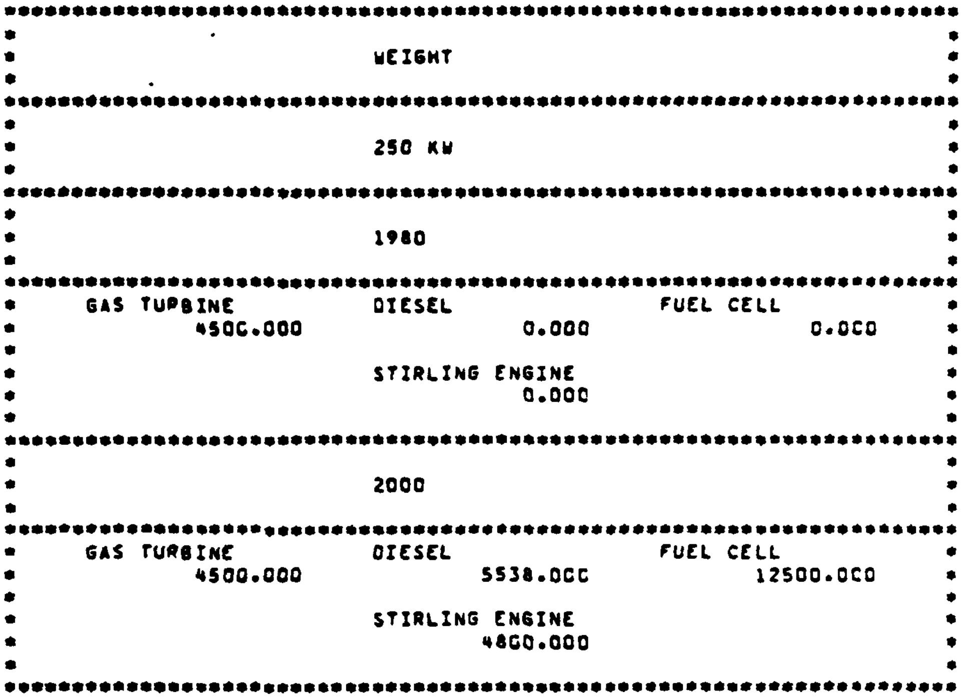
Figure 7 - Continued



```
*****************************************************************
*                                                               *
*                         50 KW                                 *
*                                                               *
*****************************************************************
*                                                               *
*                         1980                                  *
*                                                               *
*****************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL      *
*              47.500               0.000                0.000  *
*                                                               *
*                          STIRLING ENGINE                      *
*                                   0.000                       *
*                                                               *
*****************************************************************
*                                                               *
*                         2000                                  *
*                                                               *
*****************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL      *
*              47.500              70.000               30.000  *
*                                                               *
*                          STIRLING ENGINE                      *
*                                  30.000                       *
*                                                               *
*****************************************************************
```

```
*****************************************************************
*                                                               *
*                         10 KW                                 *
*                                                               *
*****************************************************************
*                                                               *
*                         1980                                  *
*                                                               *
*****************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL      *
*              12.500               0.000                0.000  *
*                                                               *
*                          STIRLING ENGINE                      *
*                                   0.000                       *
*                                                               *
*****************************************************************
*                                                               *
*                         2000                                  *
*                                                               *
*****************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL      *
*              12.500              21.000                6.000  *
*                                                               *
*                          STIRLING ENGINE                      *
*                                  12.000                       *
*                                                               *
*****************************************************************
```

Figure 7 - Continued



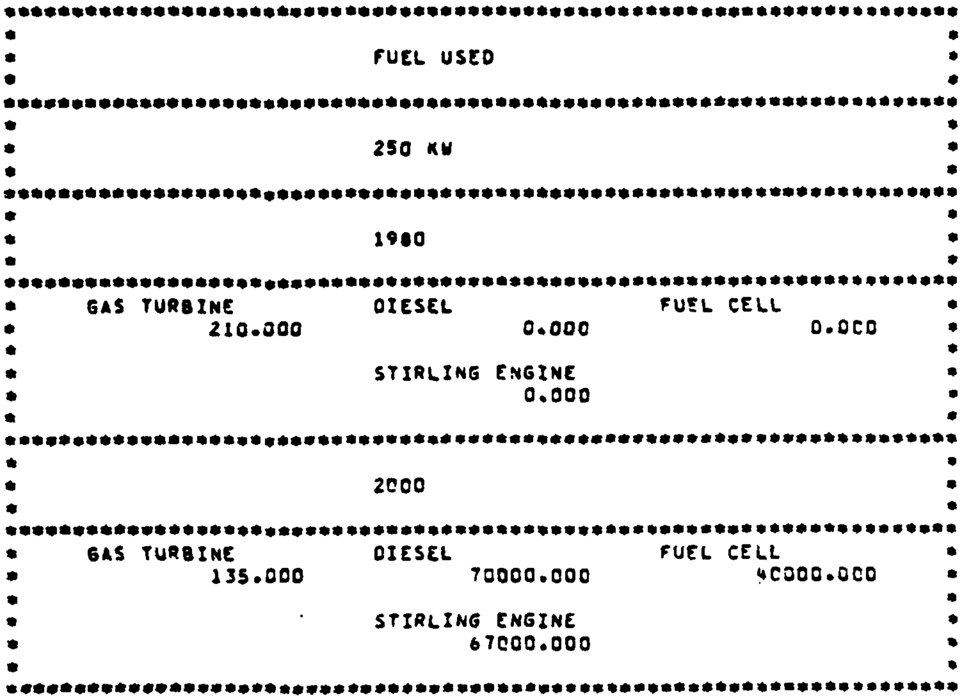
```
******************************************************************
*                                                                *
*                        WEIGHT                                  *
*                                                                *
******************************************************************
*                                                                *
*                        250 KW                                  *
*                                                                *
******************************************************************
*                                                                *
*                        1980                                    *
*                                                                *
******************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL           *
*            4500.000               0.000               0.000    *
*                                                                *
*                        STIRLING ENGINE                         *
*                                   0.000                        *
*                                                                *
******************************************************************
*                                                                *
*                        2000                                    *
*                                                                *
******************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL           *
*            4500.000            5538.000           12500.000    *
*                                                                *
*                        STIRLING ENGINE                         *
*                                4800.000                        *
*                                                                *
******************************************************************
```

Figure 7 - Continued

```
***********************************************************************
*                                                                     *
*                          50 KW                                      *
*                                                                     *
***********************************************************************
*                                                                     *
*                          1980                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*             1000.000                0.000                0.000      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                     0.000                           *
*                                                                     *
***********************************************************************
*                                                                     *
*                          2000                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*             1000.000             1895.000             4000.000      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                   600.000                           *
*                                                                     *
***********************************************************************
```

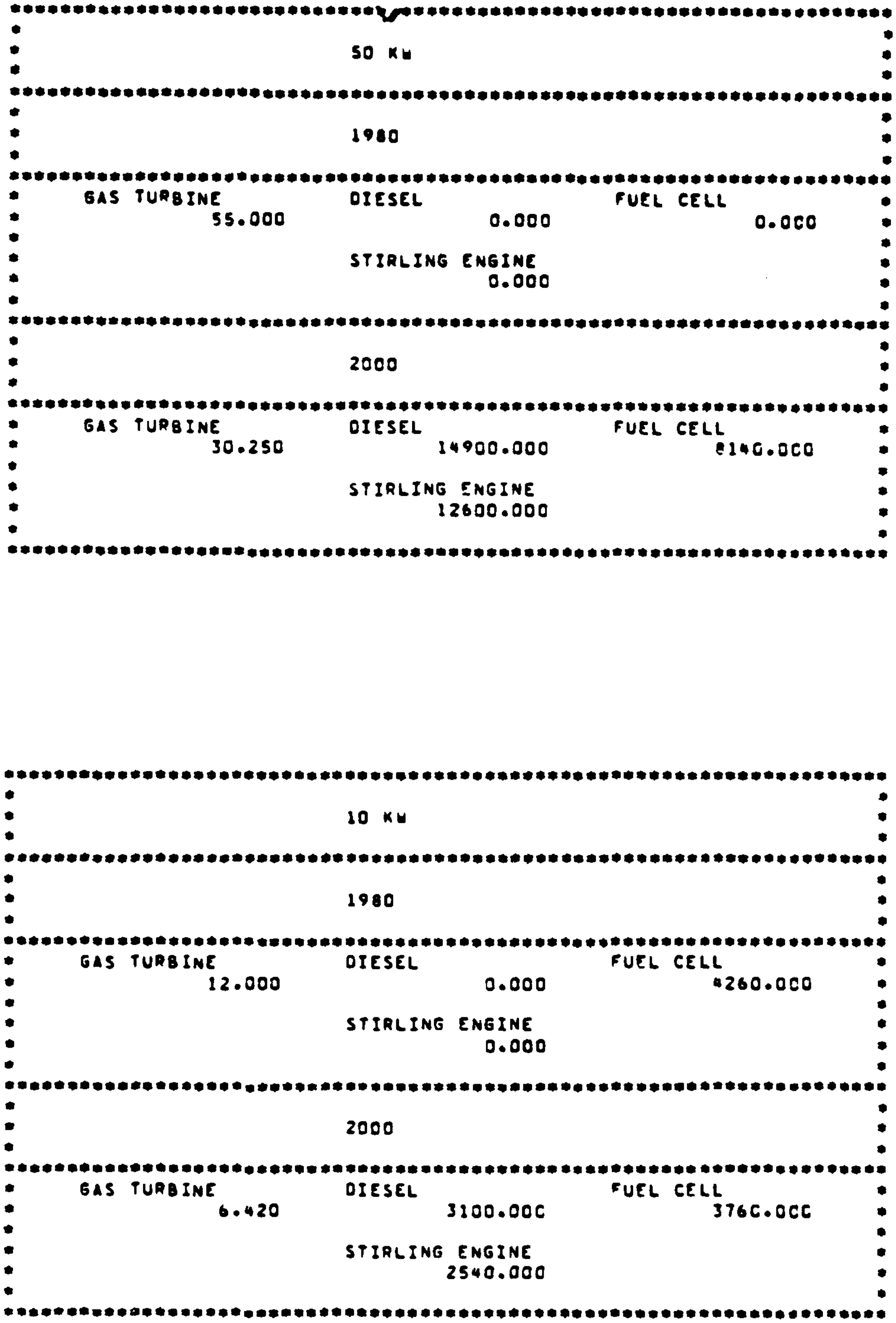
```
***********************************************************************
*                                                                     *
*                          10 KW                                      *
*                                                                     *
***********************************************************************
*                                                                     *
*                          1980                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*              200.000                0.000                0.000      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                     0.000                           *
*                                                                     *
***********************************************************************
*                                                                     *
*                          2000                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*              200.000              483.000              400.000      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                   220.000                           *
*                                                                     *
***********************************************************************
```

Figure 7 - Continued



```
***************************************************************
*                                                             *
*                         FUEL USED                           *
*                                                             *
***************************************************************
*                                                             *
*                         250 KW                              *
*                                                             *
***************************************************************
*                                                             *
*                         1980                                *
*                                                             *
***************************************************************
*    GAS TURBINE          DIESEL              FUEL CELL       *
*            210.000              0.000                0.000  *
*                                                             *
*                         STIRLING ENGINE                     *
*                                 0.000                       *
*                                                             *
***************************************************************
*                                                             *
*                         2000                                *
*                                                             *
***************************************************************
*    GAS TURBINE          DIESEL              FUEL CELL       *
*            135.000          70000.000            40000.000  *
*                                                             *
*                         STIRLING ENGINE                     *
*                             67000.000                       *
*                                                             *
***************************************************************
```

Figure 7 - Continued



```
********************************************************************
*                                                                  *
*                          50 KW                                   *
*                                                                  *
********************************************************************
*                                                                  *
*                          1980                                    *
*                                                                  *
********************************************************************
*     GAS TURBINE             DIESEL                FUEL CELL      *
*               55.000                  0.000                0.000 *
*                                                                  *
*                             STIRLING ENGINE                      *
*                                       0.000                      *
*                                                                  *
********************************************************************
*                                                                  *
*                          2000                                    *
*                                                                  *
********************************************************************
*     GAS TURBINE             DIESEL                FUEL CELL      *
*               30.250              14900.000             8140.000 *
*                                                                  *
*                             STIRLING ENGINE                      *
*                                   12600.000                      *
*                                                                  *
********************************************************************


********************************************************************
*                                                                  *
*                          10 KW                                   *
*                                                                  *
********************************************************************
*                                                                  *
*                          1980                                    *
*                                                                  *
********************************************************************
*     GAS TURBINE             DIESEL                FUEL CELL      *
*               12.000                  0.000             4260.000 *
*                                                                  *
*                             STIRLING ENGINE                      *
*                                       0.000                      *
*                                                                  *
********************************************************************
*                                                                  *
*                          2000                                    *
*                                                                  *
********************************************************************
*     GAS TURBINE             DIESEL                FUEL CELL      *
*                6.420               3100.000             3760.000 *
*                                                                  *
*                             STIRLING ENGINE                      *
*                                    2540.000                      *
*                                                                  *
********************************************************************
```

Figure 7 - Continued

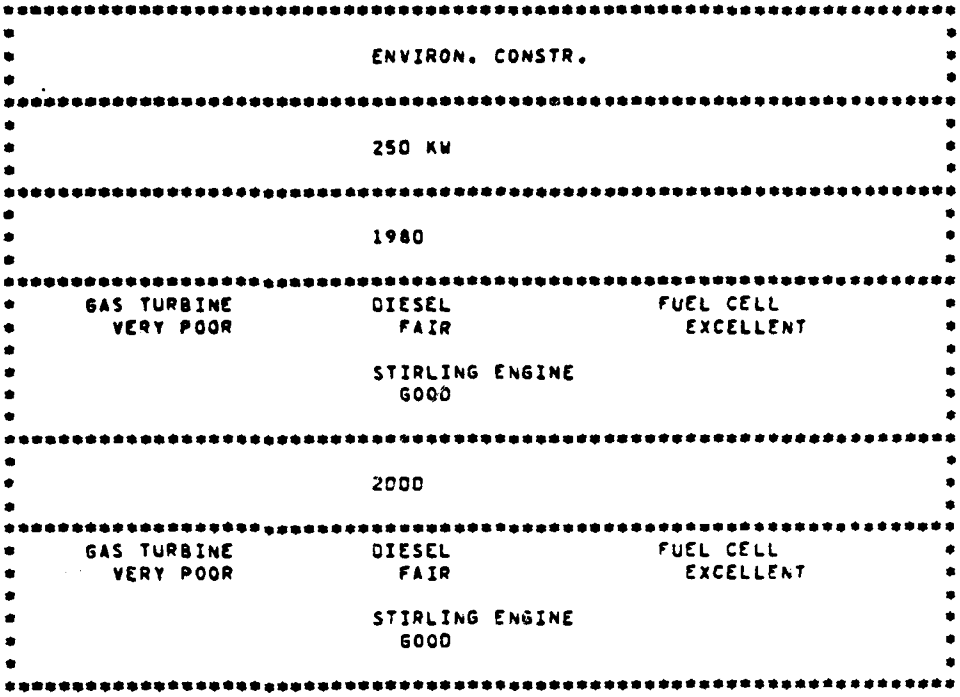
```
*******************************************************************
*                                                                 *
*                         GROWTH POTENTIAL                        *
*                                                                 *
*******************************************************************
*                                                                 *
*                         250 KW                                  *
*                                                                 *
*******************************************************************
*                                                                 *
*                         1980                                    *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL              FUEL CELL           *
*       POOR                POOR                GOOD              *
*                                                                 *
*                         STIRLING ENGINE                         *
*                           POOR                                  *
*                                                                 *
*******************************************************************
*                                                                 *
*                         2000                                    *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL              FUEL CELL           *
*       POOR                POOR                GOOD              *
*                                                                 *
*                         STIRLING ENGINE                         *
*                           POOR                                  *
*                                                                 *
*******************************************************************
```

Figure 7 - Continued

```
***********************************************************************
*                                                                     *
*                          50 KW                                      *
*                                                                     *
***********************************************************************
*                                                                     *
*                          1980                                       *
*                                                                     *
***********************************************************************
*     GAS TUPBINE          DIESEL                FUEL CELL            *
*       POOR                 POOR                  GOOD               *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            POOR                                     *
*                                                                     *
***********************************************************************
*                                                                     *
*                          2000                                       *
*                                                                     *
***********************************************************************
*     GAS TUPBINE          DIESEL                FUEL CELL            *
*       POOR                 POOR                  GOOD               *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            POOR                                     *
*                                                                     *
***********************************************************************
```

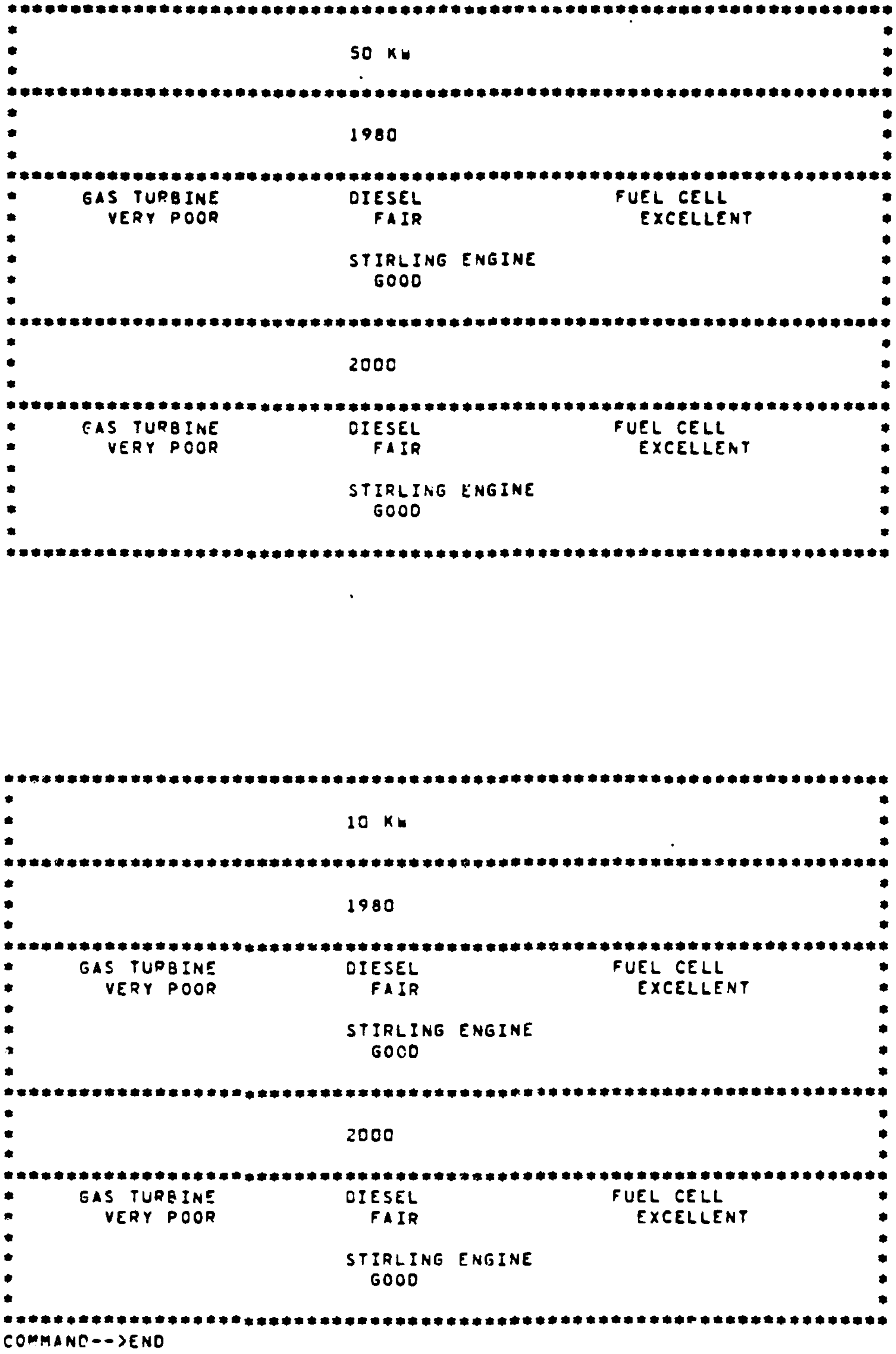
```
***********************************************************************
*                                                                     *
*                          10 KW                                      *
*                                                                     *
***********************************************************************
*                                                                     *
*                          1980                                       *
*                                                                     *
***********************************************************************
*     GAS TUPBINE          DIESEL                FUEL CELL            *
*       POOR                 POOR                  GOOD               *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            POOR                                     *
*                                                                     *
***********************************************************************
*                                                                     *
*                          2000                                       *
*                                                                     *
***********************************************************************
*     GAS TUPBINE          DIESEL                FUEL CELL            *
*       POOR                 POOP                  GOOD               *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            POOR                                     *
*                                                                     *
***********************************************************************
```

Figure 7 - Continued



```
************************************************************************
*                                                                      *
*                          ENVIRON. CONSTR.                            *
*                                                                      *
************************************************************************
*                                                                      *
*                          250 KW                                      *
*                                                                      *
************************************************************************
*                                                                      *
*                          1980                                        *
*                                                                      *
************************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL             *
*       VERY POOR            FAIR                  EXCELLENT           *
*                                                                      *
*                          STIRLING ENGINE                             *
*                            GOOD                                      *
*                                                                      *
************************************************************************
*                                                                      *
*                          2000                                        *
*                                                                      *
************************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL             *
*       VERY POOR            FAIR                  EXCELLENT           *
*                                                                      *
*                          STIRLING ENGINE                             *
*                            GOOD                                      *
*                                                                      *
************************************************************************
```

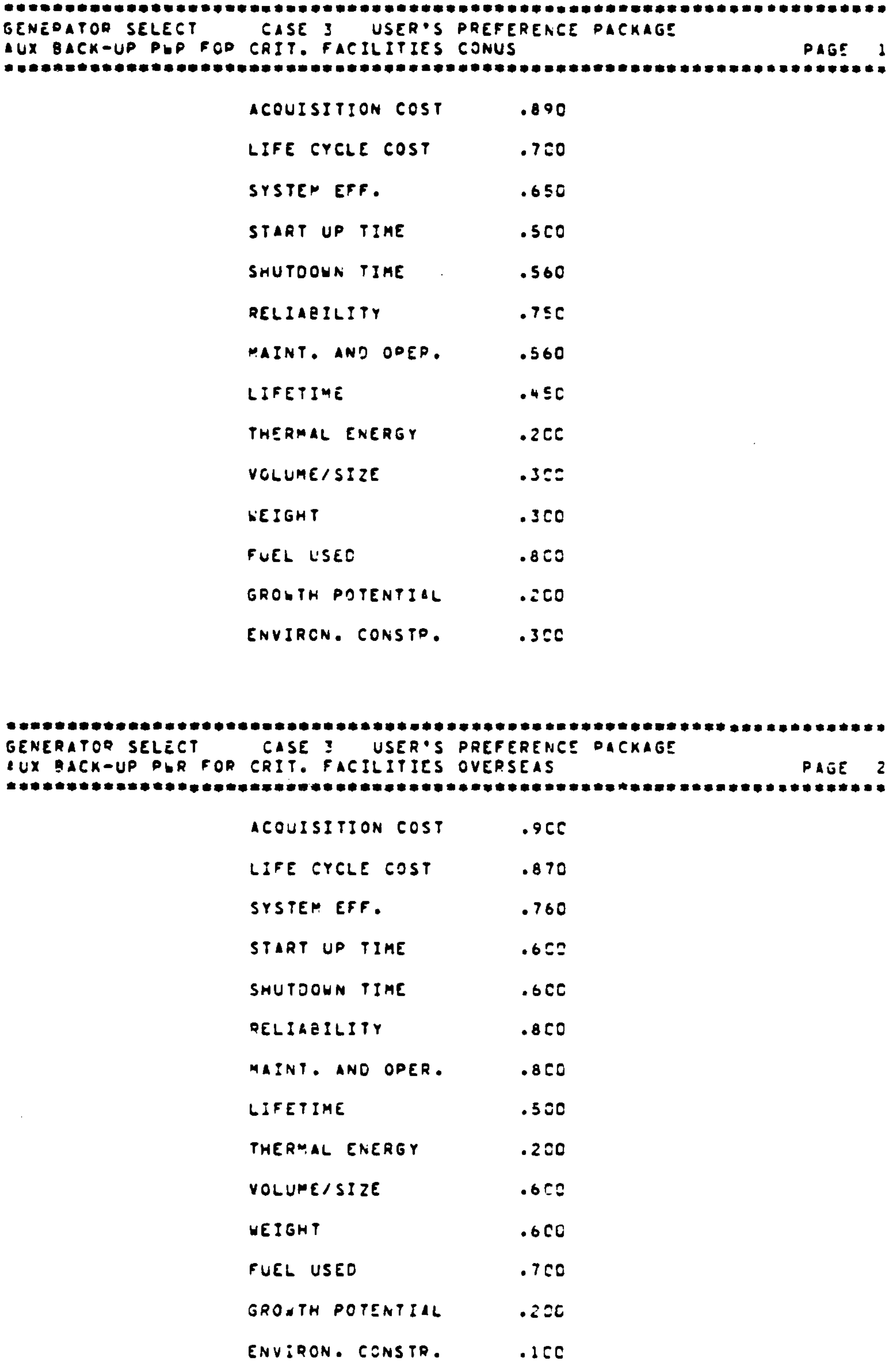
Figure 7 - Continued



```
***********************************************************************
*                                                                     *
*                          50 KW                                      *
*                                                                     *
***********************************************************************
*                                                                     *
*                          1980                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*       VERY POOR            FAIR                 EXCELLENT           *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            GOOD                                     *
*                                                                     *
***********************************************************************
*                                                                     *
*                          2000                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*       VERY POOR            FAIR                 EXCELLENT           *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            GOOD                                     *
*                                                                     *
***********************************************************************
```

```
***********************************************************************
*                                                                     *
*                          10 KW                                      *
*                                                                     *
***********************************************************************
*                                                                     *
*                          1980                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*       VERY POOR            FAIR                 EXCELLENT           *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            GOOD                                     *
*                                                                     *
***********************************************************************
*                                                                     *
*                          2000                                       *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*       VERY POOR            FAIR                 EXCELLENT           *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            GOOD                                     *
*                                                                     *
***********************************************************************
COMMAND-->END
```

Figure 7 - Concluded



```
**********************************************************************
GENERATOR SELECT      CASE 3   USER'S PREFERENCE PACKAGE
AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS                    PAGE  1
**********************************************************************

                       ACQUISITION COST       .890

                       LIFE CYCLE COST        .700

                       SYSTEM EFF.            .650

                       START UP TIME          .500

                       SHUTDOWN TIME          .560

                       RELIABILITY            .750

                       MAINT. AND OPER.       .560

                       LIFETIME               .450

                       THERMAL ENERGY         .200

                       VOLUME/SIZE            .300

                       WEIGHT                 .300

                       FUEL USED              .800

                       GROWTH POTENTIAL       .200

                       ENVIRON. CONSTR.       .300


**********************************************************************
GENERATOR SELECT      CASE 3   USER'S PREFERENCE PACKAGE
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS                 PAGE  2
**********************************************************************

                       ACQUISITION COST       .900

                       LIFE CYCLE COST        .870

                       SYSTEM EFF.            .760

                       START UP TIME          .600

                       SHUTDOWN TIME          .600

                       RELIABILITY            .800

                       MAINT. AND OPER.       .800

                       LIFETIME               .500

                       THERMAL ENERGY         .200

                       VOLUME/SIZE            .600

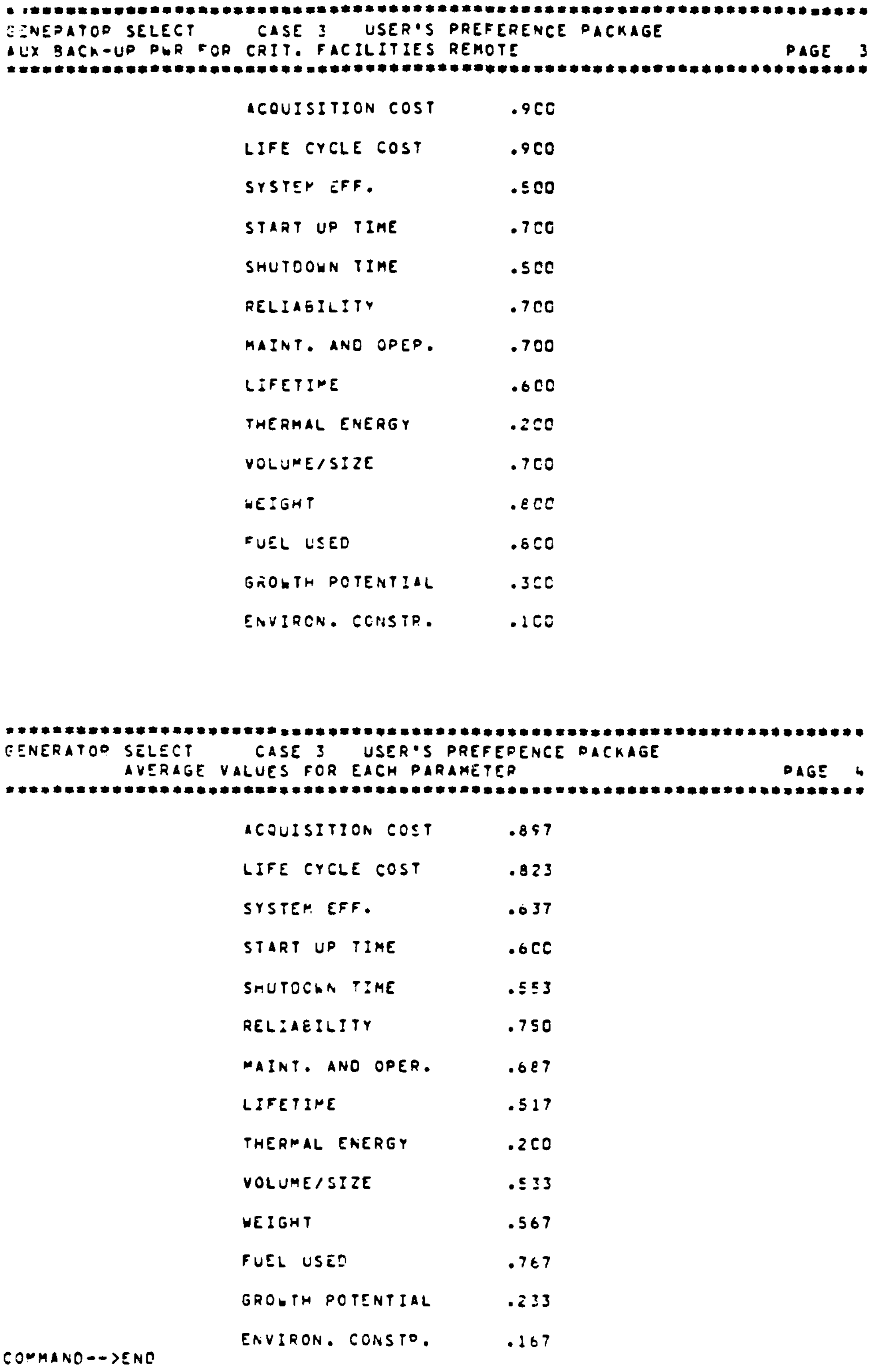
                       WEIGHT                 .600

                       FUEL USED              .700

                       GROWTH POTENTIAL       .200

                       ENVIRON. CONSTR.       .100
```

Figure 8 - Output From The UPPP Program



```
*************************************************************************
GENERATOR SELECT     CASE 3   USER'S PREFERENCE PACKAGE
AUX BACK-UP PWR FOR CRIT. FACILITIES REMOTE                     PAGE  3
*************************************************************************

                         ACQUISITION COST        .900

                         LIFE CYCLE COST         .900

                         SYSTEM EFF.             .500

                         START UP TIME           .700

                         SHUTDOWN TIME           .500

                         RELIABILITY             .700

                         MAINT. AND OPER.        .700

                         LIFETIME                .600

                         THERMAL ENERGY          .200

                         VOLUME/SIZE             .700

                         WEIGHT                  .800

                         FUEL USED               .600

                         GROWTH POTENTIAL        .300

                         ENVIRON. CONSTR.        .100


*************************************************************************
GENERATOR SELECT     CASE 3   USER'S PREFERENCE PACKAGE
          AVERAGE VALUES FOR EACH PARAMETER                     PAGE  4
*************************************************************************

                         ACQUISITION COST        .897

                         LIFE CYCLE COST         .823

                         SYSTEM EFF.             .637

                         START UP TIME           .600

                         SHUTDOWN TIME           .553

                         RELIABILITY             .750

                         MAINT. AND OPER.        .687

                         LIFETIME                .517

                         THERMAL ENERGY          .200

                         VOLUME/SIZE             .533

                         WEIGHT                  .567

                         FUEL USED               .767

                         GROWTH POTENTIAL        .233

                         ENVIRON. CONSTR.        .167
COMMAND-->END
```

Figure 8 - Concluded

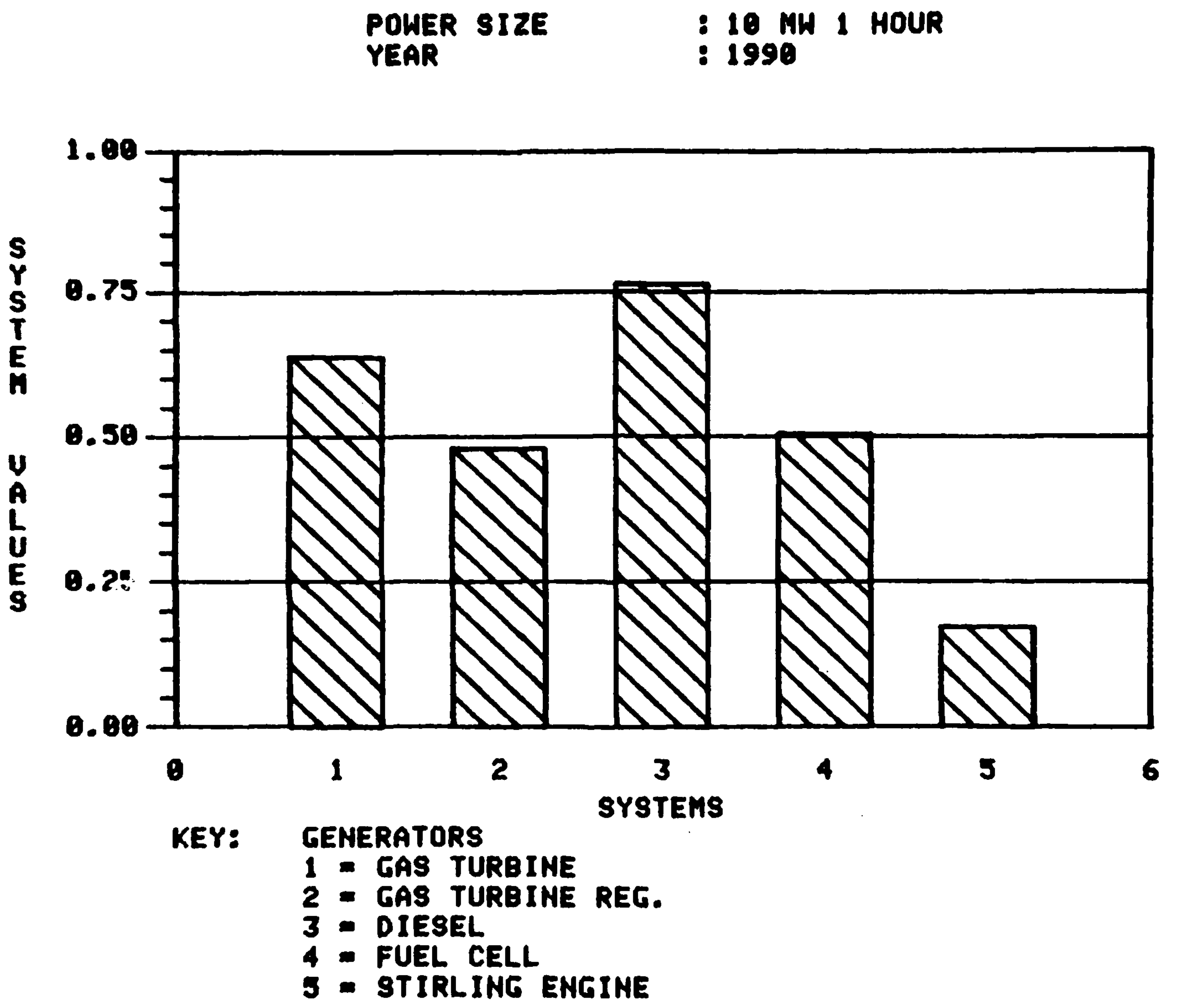


Figure 9. Grapics Output For Generator Selection Problem

3. PROCEDURES FOR USE

To execute the programs interactively, a PROCEDURE file has been set up so that the user has only one command to issue in order to run the programs.

A PROCEDURE file is a file containing system commands. The first line is the header statement, and it defines the file as a PROCEDURE file and identifies any keywords. When a PROCEDURE file is called up, the values for the keywords are substituted for any keywords specified in the file. The procedure is called by a BEGIN command. The BEGIN command states the procedure name as on the header statement, the name of the PROCEDURE file, and, if any, values for the keywords.

In the PROCEDURE files, file names are given as keywords. Therefore, different file names can be specified when running different problems. Different PROCEDURE files are available when the programs are used for different functions because the handling of the files differs from function to function. When the programs are used to create the data files, the PROCEDURE file issues the necessary commands to set up the new files as permanent files. The user then issues the CATALOG command to make the files permanent. If the data files are already present, another PROCEDURE file is used. Listings of these PROCEDURE files are available in Appendix J. Further information of PROCEDURE files with the CDC CYBER 175 is available in NOS/BE Version 1: Reference Manual.

On Wright-Patterson's CDC computer the following command should be issued to gain access to INTERCOM (interactive mode): LOGIN, problem number, password. Then the following commands should be issued for the various programs:

a. Parameter package program (PPP)

(1) To create the parameter package (PP) and the HEADER file:

```
ATTACH,PPROC1
BEGIN,PPPP,PPROC1,filename1,filename2
```

where: filename1 is the desired permanent filename for the HEADER file to be created, and filename2 is the similar name for the PP file.

NOTE: No filenames discussed in this section may be exactly the names "HEADER", "PP", or "UPP".

(2) PPP program commands:

CRTE--creates a new data base, or in other words, a new HEADER file

MNIN--allows entering of parameter values, if user has no data file already made up

LIST--lists all parameter data contained in PP

END --ends the program

b. User's preference package program (UPPP)

(1) To create the user's preference package (UPP) file:

```
ATTACH,UPROC1
BEGIN,UPPPP,UPROC1,filename1,cy1,filename2,
filename3
```

where: filename1 and cy1 are the filename and cycle number of the HEADER file, which must already exist as a permanent file and must not be attached, and filename2 and filename3 are the desired filenames of the UPP file and the new, annotated HEADER file, both of which are to be created.

(2) UPPP program commands:

CRTE--creates new user's preference package (UPP)

ADD --adds scenarios to an already-existing UPP

LIST--lists the scenarios and their parameter ratings

END --ends the program

(3) The new HEADER file and the UPP file created must be CATALOGed as above.

(4) To add scenarios to a previously created UPP:

```
ATTACH,UPROC2
BEGIN,UPPPP,UPROC2,filename1,cy1,filename2,cy2,filename3,filename4
```

where: filename1,cy1 and filename2,cy2 represent the filenames and cycle numbers of the existing HEADER and UPP files, and filename3 and filename4 are the new filenames for the appended versions of these files.

c. System selection model program (SSMP)

(1) To run program:

```
ATTACH,IPROC
BEGIN,SSMPP,IPROC,filename1,cy1,filename2,cy2,filename3,cy3
```

where: filename1,cy1 pertain to the PP file,
filename2,cy2 to the UPP file,
and filename3,cy3 to the HEADER file

To run larger problems, all these programs may be executed in batch mode. This is particularly desirable when entering data interactively becomes a long, cumbersome task, and for problems larger than the size limits specified above, SSMP must be executed in batch mode. Instructions and further explanation are contained in Appendix B.

SECTION V

PROGRAMMING SPECIFICATIONS

1. PROGRAM OVERVIEW

The main program is the system selection model program (SSMP) which is used to select the best system by integrating the system parameters and the user's parameter ratings. The SSMP has three data bases: (1) parameter package (PP), which contains the system parameter data; (2) user's preference package (UPP), which contains the user's ratings of the system parameters; and (3), HEADER which contains information on the structure of the problem and titles.

Two supporting programs develop these data bases. The parameter package program (PPP) develops the PP and HEADER files. The user's preference package program (UPPP) uses the information from HEADER as input and outputs UPP as a file. See Figure 8.

To set up a problem the PPP and UPP are executed in order to provide the data bases for the SSMP. Once these data bases are set up, the system selection model program can be executed as many times as needed. It is not necessary to execute the two supporting programs each time the SSMP is run.

Each of these programs can be executed interactively on Wright-Patterson's CDC CYBER 175. The SSMP consists of two programs, the first of which contains everything but the graphics. The second set of programs, the graphics programs GRAPHX and GRAPHT, contain the FORTRAN codings to utilize the Tektronix PLOT-10 software subroutines which actually perform the graphics work.

The user of the SSMP cannot tell that there are two separate programs because the programs are executed together under a PROCEDURE file. This PROCEDURE file not only executes the two programs but also attaches and returns data files. The reason for this separation is two-fold: first, each SSMP program requires so much memory allocation that it is impossible to have the programs run interactively together as one program; and second, the graphics programs are presented as an option.

To further reduce the amount of storage required, the three programs for SSMP are divided into overlays. The program modules are structured into overlay trees as shown in Figures 10 and 11. The main overlay which is designated as level (0,0) remains in memory during job execution. Beneath the main overlay are the primary overlays, which are called from the main overlay. The primary levels are, for example, (1,0), (2,0), (3,0)... Under a primary overlay, a hierarchy of secondary overlays can exist. The secondary overlays are loaded in response to a CALL statement issued in the primary overlay. Examples of secondary overlays associated with the primary overlay (1,0) are: (1,1), (1,2), (1,3), and (1,4).

The array dimensions are kept consistent throughout SSMP and the supporting programs. The dimensions for each array are set at the maximum value that will allow the program to run interactively. The dimensions of these arrays therefore limit the sizes of the problems that can be run interactively. To run larger problems will require the user to increase array dimensions and run the program in batch mode. The program that can handle larger problems is called SSMPB and is described in Appendix B. Of course, the dimensions may change from computer system to computer system.

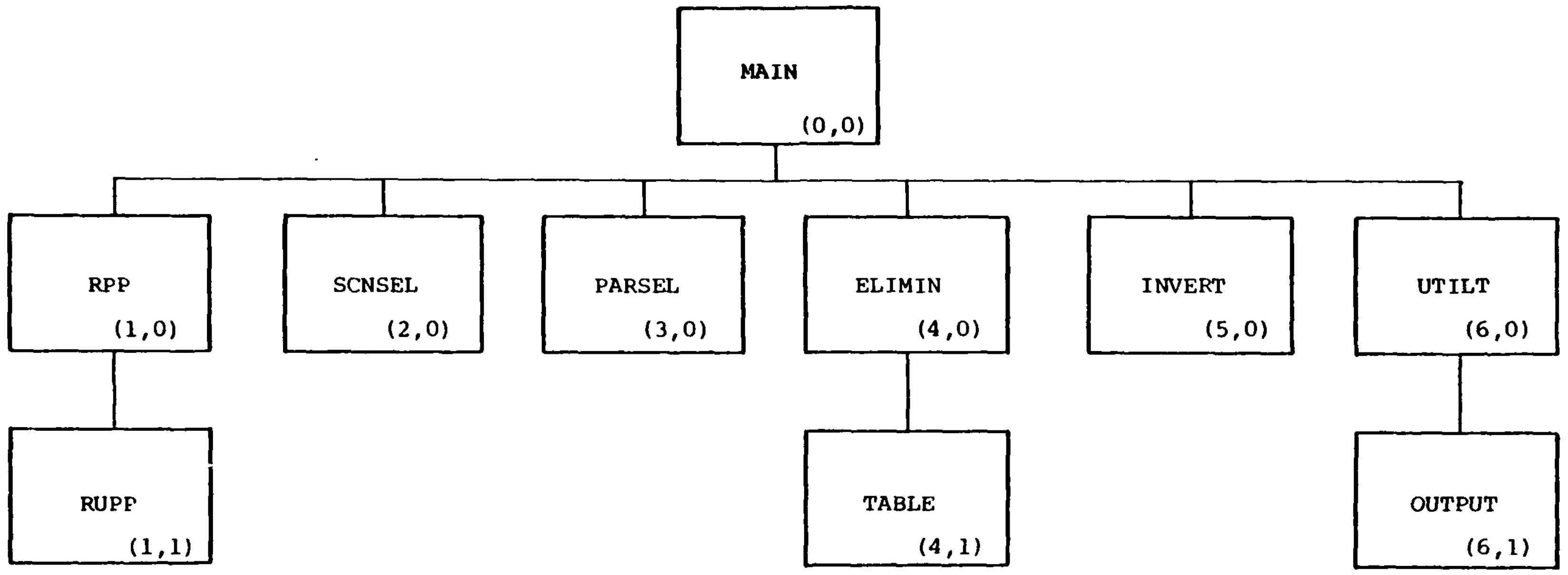


Figure 10. Overlay Tree for SSMP

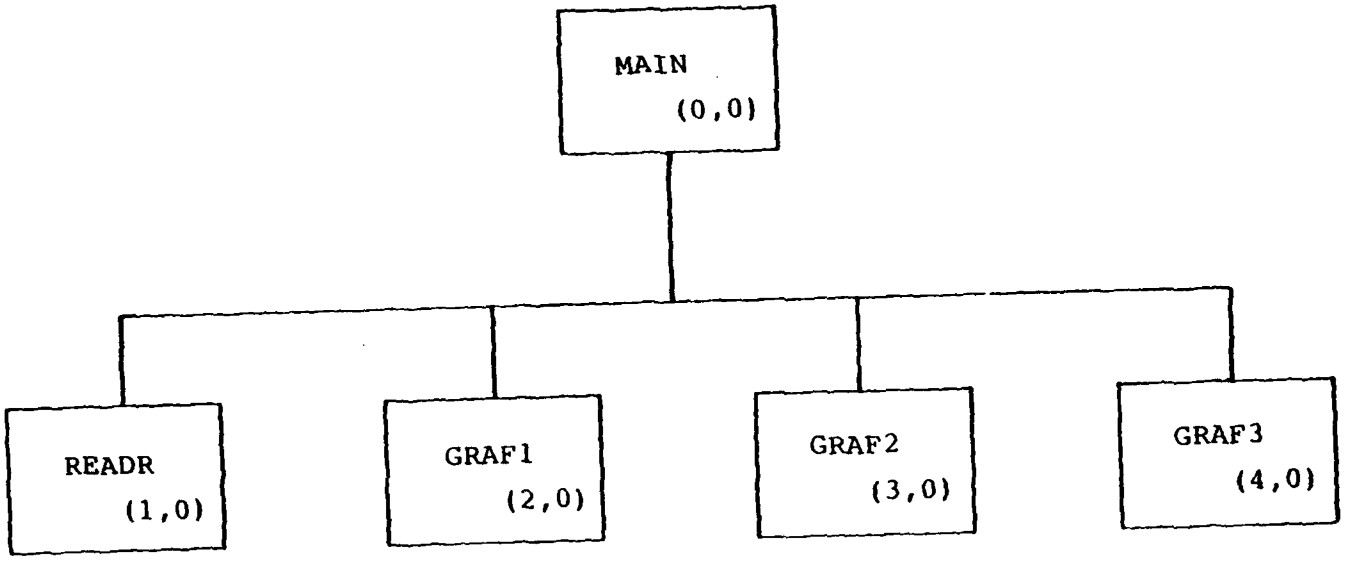


Figure 11. Overlay Tree for GRAPHX

A user on a different computer system may be able to set up these programs as a library. To facilitate this potential setup, the COMMON statements and variable names are kept the same between programs.

Section II suggests methods to change the overlay program modules to subroutines.

Besides the three data files discussed above, other data files exist which are used to reduce the number of arrays. These files are created by SSMP during its execution. These files are VPARM and SYSNUM. The interaction of SSMP and its files is shown in Figure 12. The structure and description of the data in these files are given in Section V.2.

2. DATA STRUCTURE TABLES

This section describes the data files used in the system selection model program. Examples of the first three data files for the generator selection problem are given in Figures 17, 18, and 19.

a. HEADER

HEADER is an output file from the supporting program PPP and an input file to UPPP and SSMP.

Figure 13 shows the structure of this file.

b. User's preference package (UPP)

UPP is an output file of the user's preference package program (UPPP) and an input file to SSMP.

The file is structured in Figure 14.

c. Parameter package (PP)

PP is an output file from the parameter package program and an input file to SSMP.

The file is structured in Figu:e 15.

d. VPARM

VPARM is a file created by SSMP and used to store data during the execution of SSMP.

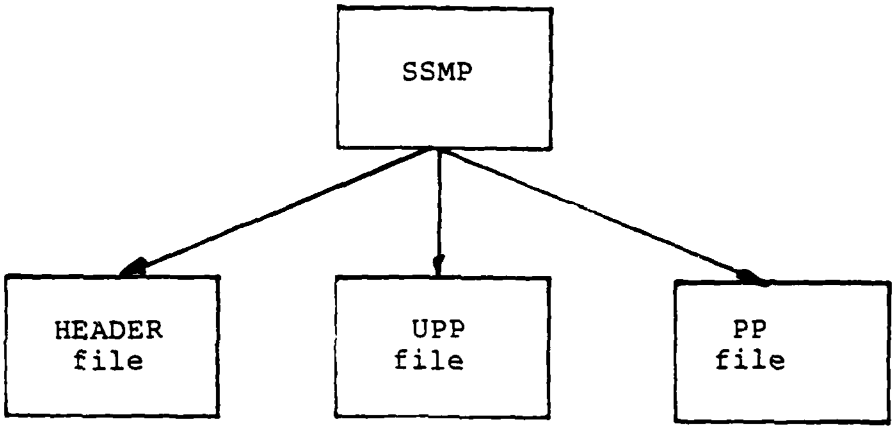


Figure 12. SSMP's Interaction with its Data File

```
SYSDSN
NSYS
NSUB1
NSUB2
NPARM
SYSSET(4)
SB1SET(4)
SB2SET(4)
SYSNAM(NSYS,4)
SUB1NM(NSUB1,4)
SUB2NM(NSUB2,4)
PARNAM(NPARM,4), NUM(NPARM), RATED(NPARM), YN(NPARM)
INVERT(NPARM)
NSCEN
SCNDSC(NSCEN,15)
```

Description:

SYSDSN-INTEGER VALUE: indicates the description of the problem

1--Indicates systems to be included.
2--Indicates systems and level 1 subsystems to be included.
3--Indicates systems, level 1 and level 2 subsystems to be included.

FORMAT (I1)

NSYS-INTEGER VALUE: number of systems.

FORMAT (I2)

NSUB1-INTEGER VALUE: number of level 1 subsystems.

FORMAT (I2)

NSUB2-INTEGER VALUE: number of level 2 subsystems per level 1 subsystem.

FORMAT (I2)

NPARM-INTEGER VALUE: number of parameters.

FORMAT (I2)

SYSSET-ALPHANUMERIC: general setname for the systems.

FORMAT (4A4)

Figure 13 - Data Structure of HEADER File

AD-A119 160 SOUTHEASTERN CENTER FOR ELECTRICAL ENGINEERING EDUCAT--ETC F/G 9/2
ADVANCED TECHNOLOGY MULTIPLE CRITERIA DECISION MODEL.(U)
NOV 81 P J SWEENEY, K B BERNER, J R FRAKER F33615-77-C-2059
UNCLASSIFIED AFWAL-TR-81-2112 NL

2 of 4
AD A
119160

SB1SET-ALPHANUMERIC: general setname for the level 1 subsystems.

FORMAT (4A4)

SB2SET-ALPHANUMERIC: general setname for the level 2 subsystems.

FORMAT (4A4)

Figure 13 - Concluded

```
RATING (1)
RATING (2)
     .
     .
     .
     .
     .
RATING (NPARM)
```

A similar block appears in the file for each scenario in the problem.

Description:

RATING-REAL VALUE: A rating for each parameter, entered by the user in the execution of the UPPP program, which indicates the relative importance of each of the parameters.

FORMAT (F5.3)

Figure 14. Data Structure of UPP File

```
PARAM(1,1), PARAM(1,2).......................PARAM(1,NSYS)
PARAM(2,1), PARAM(2,2).......................PARAM(2,NSYS)
           .                                       .
           .                                       .
           .                                       .
           .                                       .
           .                                       .
PARAM(INDEX,1), PARAM(INDEX,2)..........PARAM(INDEX,NSYS)
```

This block appears in the data file once for each parameter existing in the problem.

Description:

PARAM-REAL VALUE: contains the actual parameter data.

UNFORMATTED

NSYS-INTEGER VALUE: number of systems.

FORMAT (I2)

```
INDEX-INTEGER VALUE:  Case 1--INDEX = 1
                      Case 2--INDEX = NSUB1
                      Case 3--INDEX = NSUB1*NSUB2
```

Figure 15. Data Structure of PP File

```
SYSNRM(1,1), SYSNRM(1,2).....................SYSNRM(1,NSYS)
SYSNRM(2,1), SYSNRM(2,2).....................SYSNRM(2,NSYS)
             .                                    .
             .                                    .
             .                                    .
             .                                    .
             .                                    .
SYSNRM(INDEX,1), SYSNRM(INDEX,2).........SYSNRM(INDEX,NSYS)
```

Description:

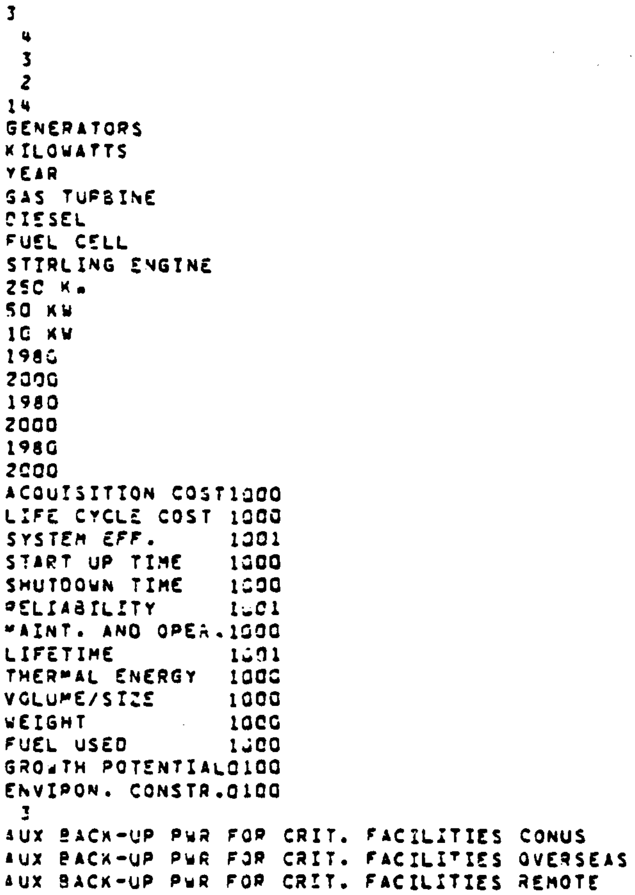
SYSNRM-REAL VALUE: normalized system utility values indicating ranking of systems.

NSYS-INTEGER VALUE: number of systems.

FORMAT (I2)

INDEX-INTEGER VALUE: Case 1--INDEX = 1
Case 2--INDEX = NSUB1
Case 3--INDEX = NSUB1*NSUB2

Figure 16. Data Structure of SYSNUM File

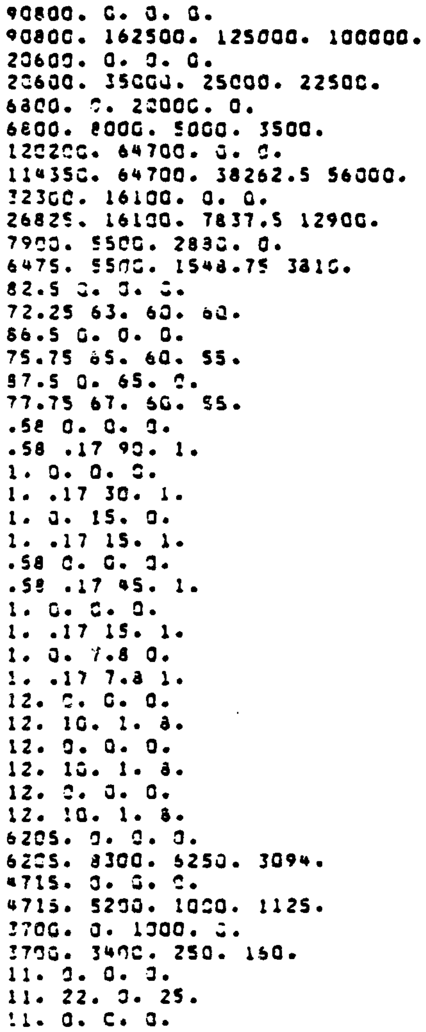


```
3
 4
 3
 2
14
GENERATORS
KILOWATTS
YEAR
GAS TURBINE
DIESEL
FUEL CELL
STIRLING ENGINE
250 K.
50 KW
10 KW
1980
2000
1980
2000
1980
2000
ACQUISITION COST1000
LIFE CYCLE COST 1000
SYSTEM EFF.     1001
START UP TIME   1000
SHUTDOWN TIME   1000
RELIABILITY     1001
MAINT. AND OPER.1000
LIFETIME        1001
THERMAL ENERGY  1000
VOLUME/SIZE     1000
WEIGHT          1000
FUEL USED       1000
GROWTH POTENTIAL0100
ENVIRON. CONSTR.0100
 3
AUX BACK-UP PWR FOR CRIT. FACILITIES CONUS
AUX BACK-UP PWR FOR CRIT. FACILITIES OVERSEAS
AUX BACK-UP PWR FOR CRIT. FACILITIES REMOTE
```

Figure 17. HEADER File for the Generator Problem

```
.890
.700
.650
.500
.560
.750
.560
.450
.200
.300
.300
.800
.200
.300
.900
.870
.760
.600
.600
.800
.800
.500
.200
.600
.600
.700
.200
.100
.900
.900
.500
.750
.500
.750
.700
.600
.200
.700
.800
.600
.300
.100
```

Figure 18. UPP File for Generator Problem



```
90800. 0. 0. 0.
90800. 162500. 125000. 100000.
20600. 0. 0. 0.
20600. 35000. 25000. 22500.
6800. 0. 22000. 0.
6800. 8000. 5000. 3500.
120200. 64700. 0. 0.
114350. 64700. 38262.5 56000.
32300. 16100. 0. 0.
26825. 16100. 7837.5 12900.
7900. 5500. 2830. 0.
6475. 5500. 1548.75 3810.
82.5 0. 0. 0.
72.25 63. 60. 60.
86.5 0. 0. 0.
75.75 65. 60. 55.
87.5 0. 65. 0.
77.75 67. 60. 55.
.58 0. 0. 0.
.58 .17 90. 1.
1. 0. 0. 0.
1. .17 30. 1.
1. 0. 15. 0.
1. .17 15. 1.
.58 0. 0. 0.
.58 .17 45. 1.
1. 0. 0. 0.
1. .17 15. 1.
1. 0. 7.8 0.
1. .17 7.8 1.
12. 0. 0. 0.
12. 10. 1. 8.
12. 0. 0. 0.
12. 10. 1. 8.
12. 0. 0. 0.
12. 10. 1. 8.
6205. 0. 0. 0.
6205. 8300. 6250. 3094.
4715. 0. 0. 0.
4715. 5200. 1000. 1125.
3700. 0. 1300. 0.
3700. 3400. 250. 160.
11. 0. 0. 0.
11. 22. 0. 25.
11. 0. 0. 0.
```

Figure 19 - PP File for Generator Problem

```
11. 13. 0. 25.
11. 0. 0. 0.
11. 9. 0. 25.
7.59 0. 0. 0.
8.69 3.1 9.2 3.7
.34 0. 0. 0.
.7 8.5 8.4 6.9
.86 0. 0. 0.
.94 6.7 5.1 7.8
150. 0. 0. 0.
150. 180. 170. 150.
47.5 0. 0. 0.
47.5 70. 30. 30.
12.5 0. 0. 0.
12.5 21. 6. 12.
4500. 0. 0. 0.
4500. 5538. 12500. 4800.
1000. 0. 0. 0.
1000. 1895. 4000. 600.
200. 0. 0. 0.
200. 483. 400. 220.
210. 0. 0. 0.
135. 70000. 40000. 67000.
55. 0. 0. 0.
30.25 14900. 8140. 12600.
12. 0. 4260. 0.
6.42 3100. 3760. 2540.
4. 4. 2. 4.
4. 4. 2. 4.
4. 4. 2. 4.
4. 4. 2.  4.
4. 4. 2. 4.
4. 4. 2. 4.
5. 3. 1. 2.
5. 3. 1. 2.
5. 3. 1. 2.
5. 3. 1. 2.
5. 3. 1. 2.
5. 3. 1. 2.
```

Figure 19 - Concluded

SECTION VI

TEST/VERIFICATION SPECIFICATIONS

1. PRODUCTION TESTING

During the coding of these programs, input data were used to run through each branch of the programs. Input used to violate program conditions included:

a. Empty input files.

b. Extraneous characters in data.

c. User input and/or file input with values which were too large or too small.

d. An improperly constructed problem tree.

e. Problem size too large for interactive executive.

2. ACCEPTANCE TEST SPECIFICATIONS

The programs will be considered suitable when:

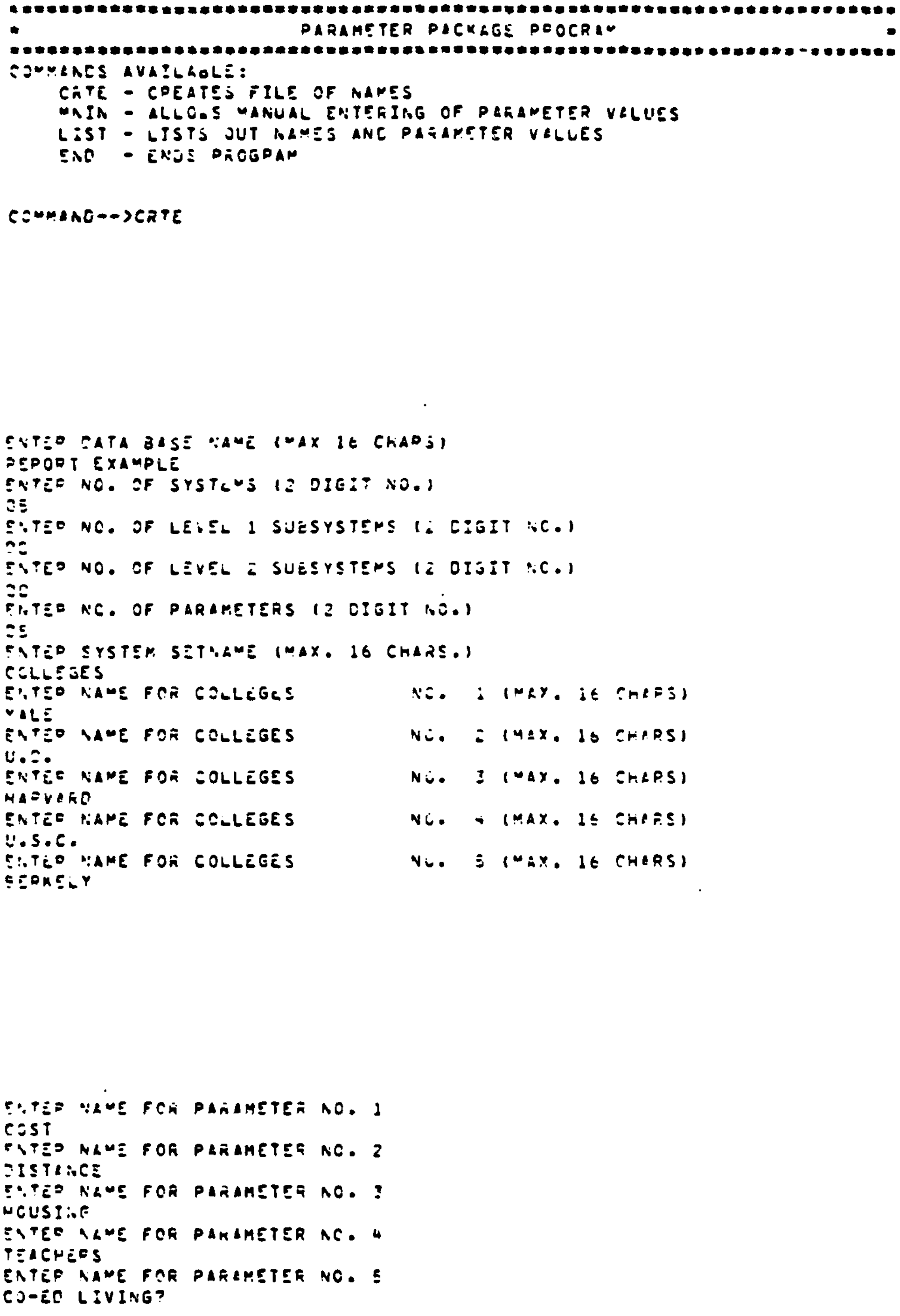
a. The programs respond correctly to the program violations as described in Section VI.1.

b. Error-free performance is observed in several test cases.

c. The correct answers are found for test data. These test data are shown in Section VI.3.

3. TEST CASES

To show that SSMP performs its calculations correctly, several test runs were made, and the results were confirmed to be accurate. Figure 20 is a test case that depicts an actual run and shows not only the final results but also the interactive commands with typical responses.



```
*****************************************************************************
*                        PARAMETER PACKAGE PROGRAM                          *
*****************************************************************************
COMMANDS AVAILABLE:
     CRTE - CREATES FILE OF NAMES
     MAIN - ALLOWS MANUAL ENTERING OF PARAMETER VALUES
     LIST - LISTS OUT NAMES AND PARAMETER VALUES
     END  - ENDS PROGRAM

COMMAND-->CRTE







ENTER DATA BASE NAME (MAX 16 CHARS)
REPORT EXAMPLE
ENTER NO. OF SYSTEMS (2 DIGIT NO.)
05
ENTER NO. OF LEVEL 1 SUBSYSTEMS (2 DIGIT NO.)
00
ENTER NO. OF LEVEL 2 SUBSYSTEMS (2 DIGIT NO.)
00
ENTER NO. OF PARAMETERS (2 DIGIT NO.)
05
ENTER SYSTEM SETNAME (MAX. 16 CHARS.)
COLLEGES
ENTER NAME FOR COLLEGES          NO.  1 (MAX. 16 CHARS)
YALE
ENTER NAME FOR COLLEGES          NO.  2 (MAX. 16 CHARS)
U.C.
ENTER NAME FOR COLLEGES          NO.  3 (MAX. 16 CHARS)
HARVARD
ENTER NAME FOR COLLEGES          NO.  4 (MAX. 16 CHARS)
U.S.C.
ENTER NAME FOR COLLEGES          NO.  5 (MAX. 16 CHARS)
BERKELY

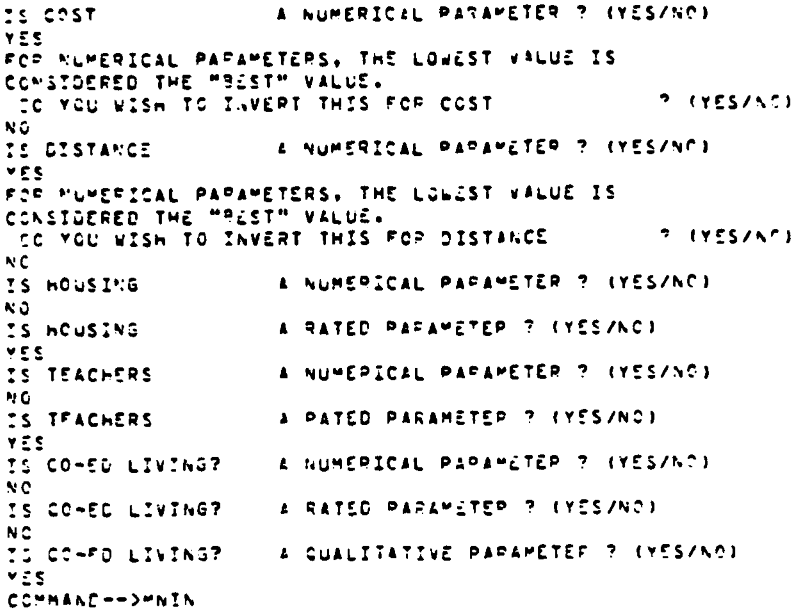







ENTER NAME FOR PARAMETER NO. 1
COST
ENTER NAME FOR PARAMETER NO. 2
DISTANCE
ENTER NAME FOR PARAMETER NO. 3
HOUSING
ENTER NAME FOR PARAMETER NO. 4
TEACHERS
ENTER NAME FOR PARAMETER NO. 5
CO-ED LIVING?
```

Figure 20 - College Run



```
IS COST              A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR COST              ? (YES/NO)
NO
IS DISTANCE          A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR DISTANCE          ? (YES/NO)
NO
IS HOUSING           A NUMERICAL PARAMETER ? (YES/NO)
NO
IS HOUSING           A RATED PARAMETER ? (YES/NO)
YES
IS TEACHERS          A NUMERICAL PARAMETER ? (YES/NO)
NO
IS TEACHERS          A RATED PARAMETER ? (YES/NO)
YES
IS CO-ED LIVING?     A NUMERICAL PARAMETER ? (YES/NO)
NO
IS CO-ED LIVING?     A RATED PARAMETER ? (YES/NO)
NO
IS CO-ED LIVING?     A QUALITATIVE PARAMETER ? (YES/NO)
YES
COMMAND-->MNIN
```

Figure 20 - Continued

```
COST

THIS IS A NUMERIC PARAMETER - ENTER A NUMBER

YALE                -- 7500
U.C.                -- 6000
HARVARD             -- 6000
U.S.C.              -- 5500
BERKELY             -- 7000
DISTANCE

THIS IS A NUMERIC PARAMETER - ENTER A NUMBER

YALE                -- 400
U.C.                -- 20
HARVARD             -- 300
U.S.C.              -- 560
BERKELY             -- 600
HOUSING

THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR

YALE                -- 2
U.C.                -- 2
HARVARD             -- 1
U.S.C.              -- 3
BERKELY             -- 2




TEACHERS

THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR

YALE                -- 1
U.C.                -- 2
HARVARD             -- 2
U.S.C.              -- 3
BERKELY             -- 1
CO-ED LIVING?

THIS IS A QUALITATIVE PARAMETER - ENTER 1 FOR YES, 0 FOR NO

YALE                -- 0
U.C.                -- 0
HARVARD             -- 0
U.S.C.              -- 1
BERKELY             -- 1
COMMAND-->LIST
```

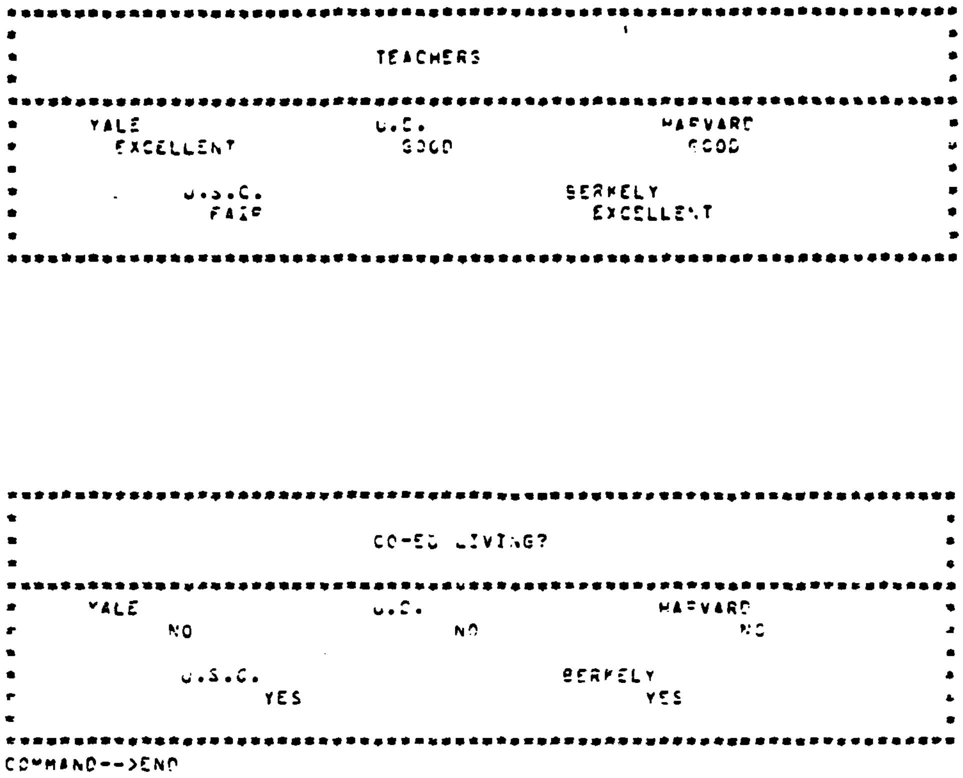
Figure 20 - Continued

```
**************************************************************
*                                                            *
*                       COST                                 *
*                                                            *
**************************************************************
*    YALE               U.C.               HARVARD           *
*           7500.000           6000.000           9000.000   *
*                                                            *
*          U.S.C.                    BERKELY                 *
*                  5500.000                 7000.000         *
*                                                            *
**************************************************************
```

```
**************************************************************
*                                                            *
*                       DISTANCE                             *
*                                                            *
**************************************************************
*    YALE               U.C.               HARVARD           *
*            400.000             20.000            300.000   *
*                                                            *
*          U.S.C.                    BERKELY                 *
*                  560.000                  600.000          *
*                                                            *
**************************************************************
```

```
**************************************************************
*                                                            *
*                       HOUSING                              *
*                                                            *
**************************************************************
*    YALE               U.C.               HARVARD           *
*      GOOD               GOOD               EXCELLENT       *
*                                                            *
*          U.S.C.                    BERKELY                 *
*            FAIR                     GOOD                   *
*                                                            *
**************************************************************
```

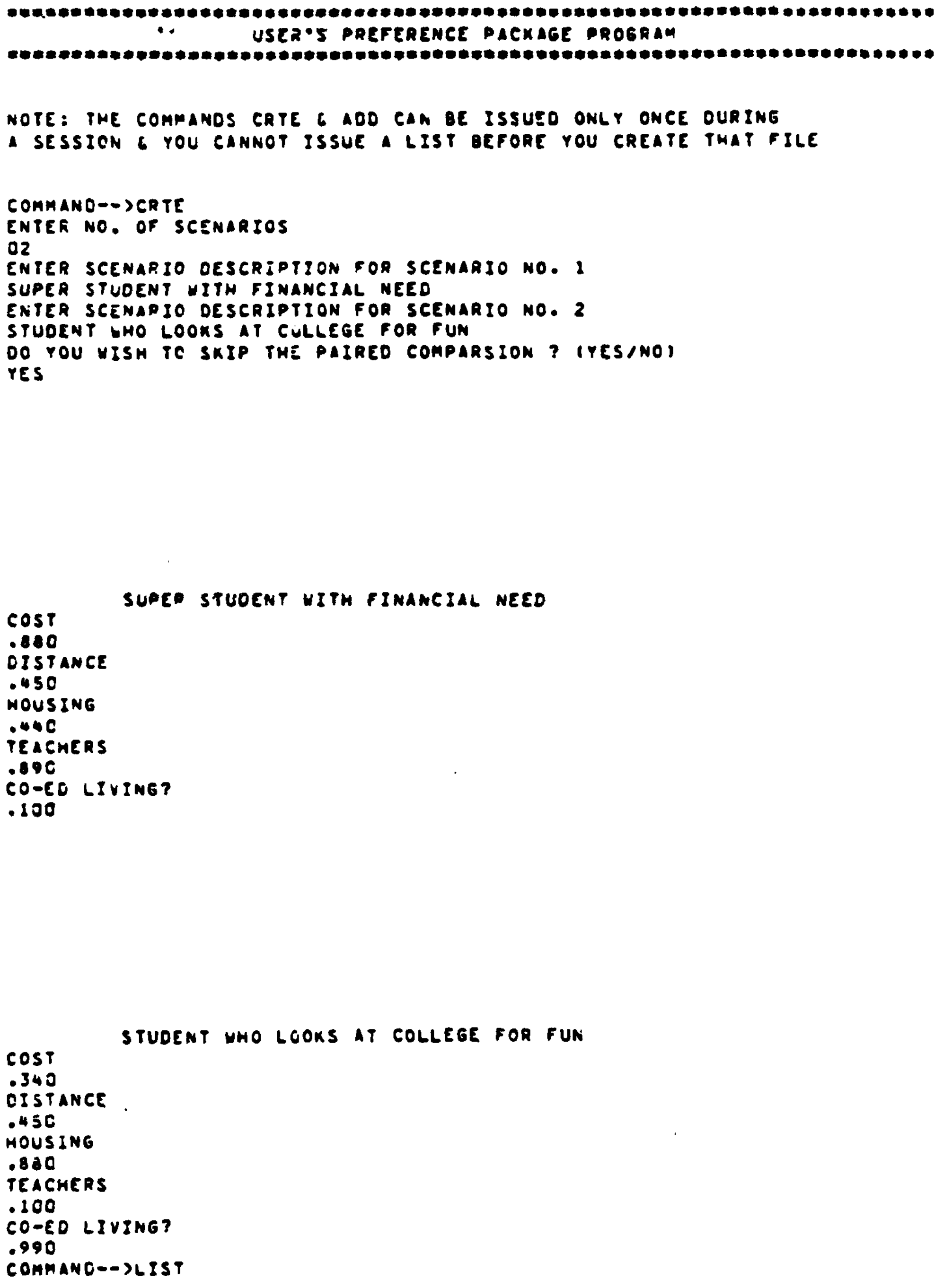
Figure 20 - Continued



```
*****************************************************************
*                                                               *
*                          TEACHERS                             *
*                                                               *
*****************************************************************
*    YALE                  U.C.                  HARVARD        *
*       EXCELLENT             GOOD                  GOOD        *
*                                                               *
*             U.S.C.                    BERKELY                 *
*                FAIR                     EXCELLENT             *
*                                                               *
*****************************************************************
```

```
*****************************************************************
*                                                               *
*                         CO-ED LIVING?                         *
*                                                               *
*****************************************************************
*    YALE                  U.C.                  HARVARD        *
*          NO                    NO                    NO       *
*                                                               *
*            U.S.C.                     BERKELY                 *
*                 YES                        YES                *
*                                                               *
*****************************************************************
COMMAND-->END
```

Figure 20 - Continued



```
**********************************************************************
                    USER'S PREFERENCE PACKAGE PROGRAM
**********************************************************************

NOTE: THE COMMANDS CRTE & ADD CAN BE ISSUED ONLY ONCE DURING
A SESSION & YOU CANNOT ISSUE A LIST BEFORE YOU CREATE THAT FILE


COMMAND-->CRTE
ENTER NO. OF SCENARIOS
02
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 1
SUPER STUDENT WITH FINANCIAL NEED
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 2
STUDENT WHO LOOKS AT COLLEGE FOR FUN
DO YOU WISH TO SKIP THE PAIRED COMPARSION ? (YES/NO)
YES








         SUPER STUDENT WITH FINANCIAL NEED
COST
.880
DISTANCE
.450
HOUSING
.440
TEACHERS
.890
CO-ED LIVING?
.100

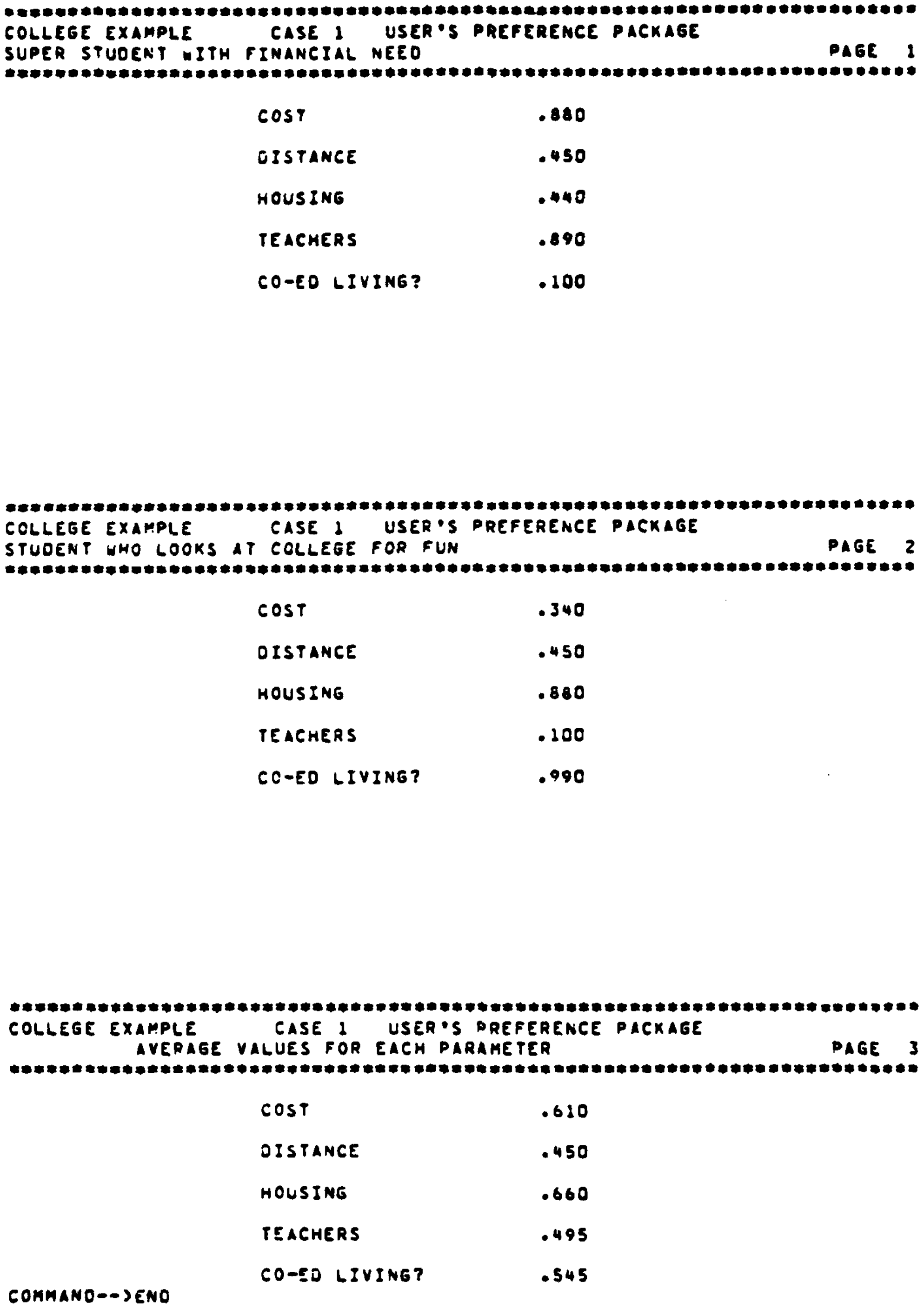







         STUDENT WHO LOOKS AT COLLEGE FOR FUN
COST
.340
DISTANCE
.450
HOUSING
.880
TEACHERS
.100
CO-ED LIVING?
.990
COMMAND-->LIST
```

Figure 20 - Continued



```
**********************************************************************
COLLEGE EXAMPLE      CASE 1   USER'S PREFERENCE PACKAGE
SUPER STUDENT WITH FINANCIAL NEED                               PAGE  1
**********************************************************************

                    COST                    .880

                    DISTANCE                .450

                    HOUSING                 .440

                    TEACHERS                .890

                    CO-ED LIVING?           .100




**********************************************************************
COLLEGE EXAMPLE      CASE 1   USER'S PREFERENCE PACKAGE
STUDENT WHO LOOKS AT COLLEGE FOR FUN                            PAGE  2
**********************************************************************

                    COST                    .340

                    DISTANCE                .450

                    HOUSING                 .880

                    TEACHERS                .100

                    CO-ED LIVING?           .990




**********************************************************************
COLLEGE EXAMPLE      CASE 1   USER'S PREFERENCE PACKAGE
          AVERAGE VALUES FOR EACH PARAMETER                     PAGE  3
**********************************************************************

                    COST                    .610

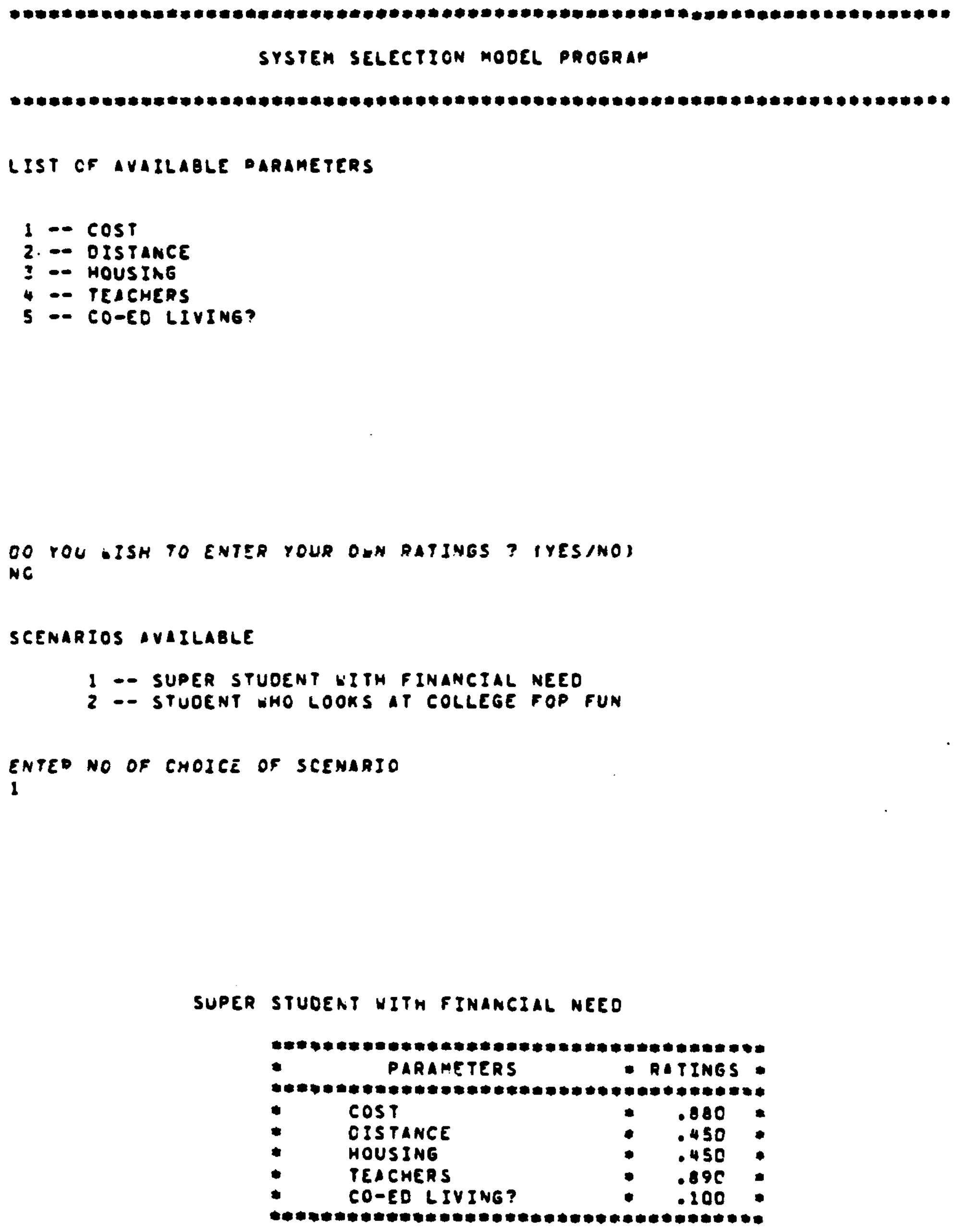
                    DISTANCE                .450

                    HOUSING                 .660

                    TEACHERS                .495

                    CO-ED LIVING?           .545
COMMAND-->END
```

Figure 20 - Continued



```
************************************************************************

                   SYSTEM SELECTION MODEL PROGRAM

************************************************************************

LIST OF AVAILABLE PARAMETERS


 1 -- COST
 2 -- DISTANCE
 3 -- HOUSING
 4 -- TEACHERS
 5 -- CO-ED LIVING?









DO YOU WISH TO ENTER YOUR OWN RATINGS ? (YES/NO)
NO


SCENARIOS AVAILABLE

      1 -- SUPER STUDENT WITH FINANCIAL NEED
      2 -- STUDENT WHO LOOKS AT COLLEGE FOR FUN


ENTER NO OF CHOICE OF SCENARIO
1

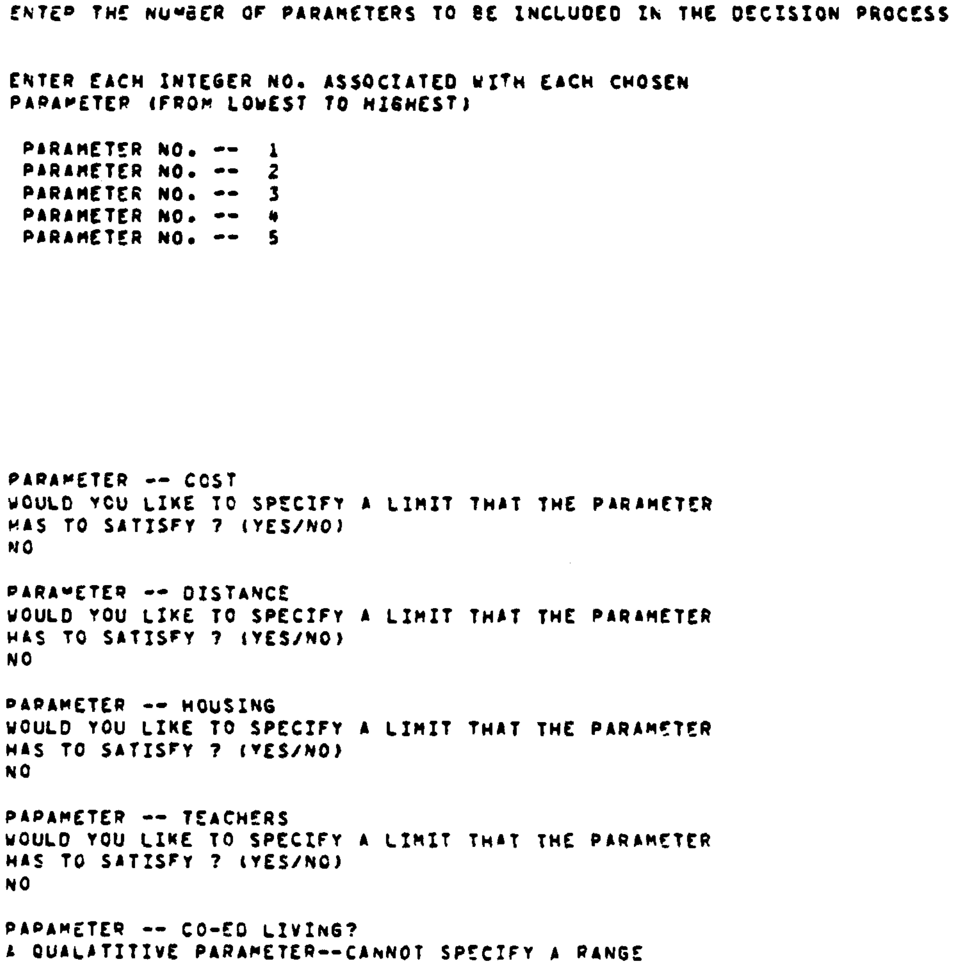





              SUPER STUDENT WITH FINANCIAL NEED

                    **************************************
                    *        PARAMETERS        * RATINGS *
                    **************************************
                    *     COST                 *   .880  *
                    *     DISTANCE             *   .450  *
                    *     HOUSING              *   .450  *
                    *     TEACHERS             *   .890  *
                    *     CO-ED LIVING?        *   .100  *
                    **************************************
```

Figure 20 - Continued



```
ENTER THE NUMBER OF PARAMETERS TO BE INCLUDED IN THE DECISION PROCESS


ENTER EACH INTEGER NO. ASSOCIATED WITH EACH CHOSEN
PARAMETER (FROM LOWEST TO HIGHEST)

 PARAMETER NO. --  1
 PARAMETER NO. --  2
 PARAMETER NO. --  3
 PARAMETER NO. --  4
 PARAMETER NO. --  5







PARAMETER -- COST
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

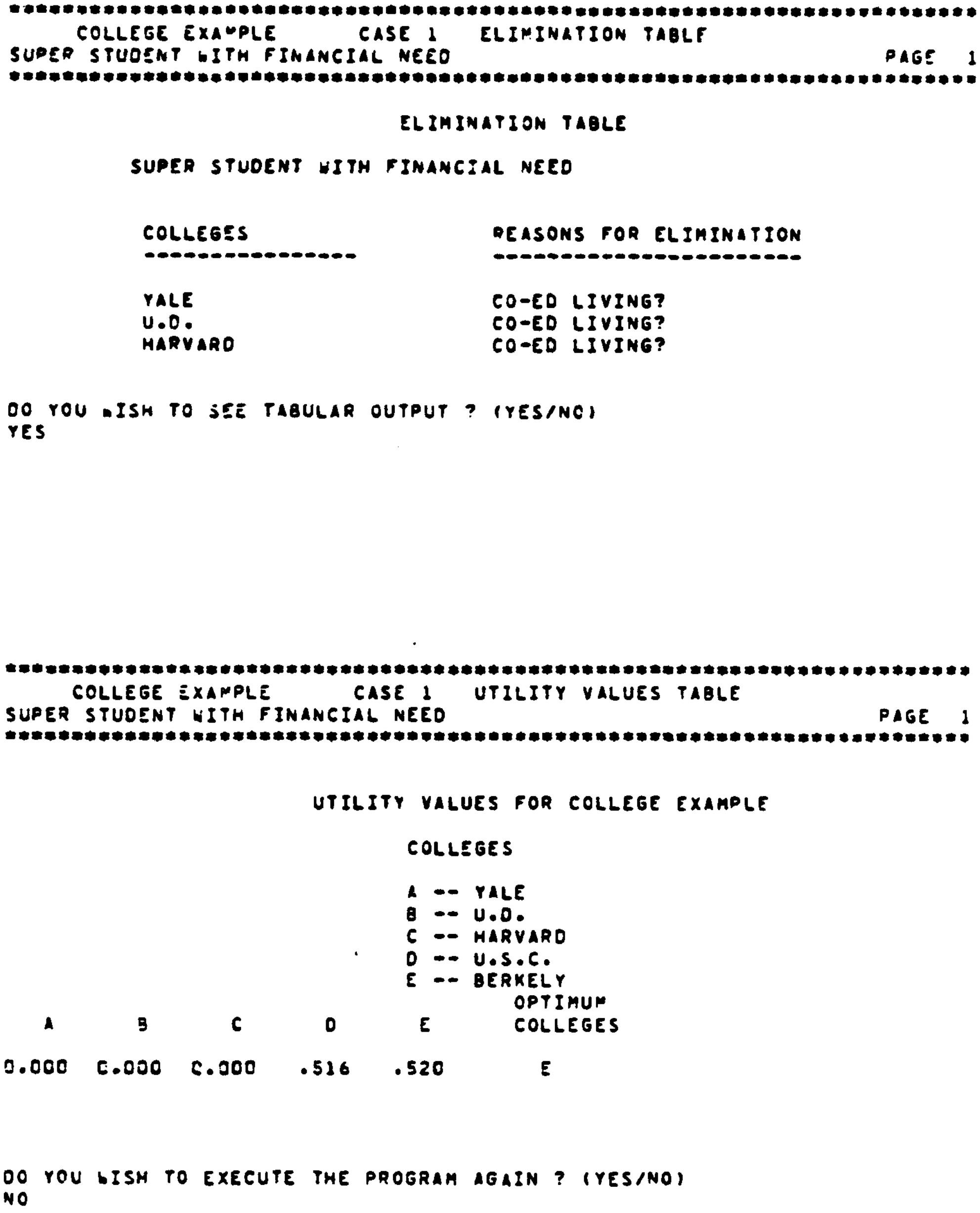
PARAMETER -- DISTANCE
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- HOUSING
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- TEACHERS
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- CO-ED LIVING?
A QUALATITIVE PARAMETER--CANNOT SPECIFY A RANGE
```

Figure 20 - Continued



```
******************************************************************************
     COLLEGE EXAMPLE       CASE 1   ELIMINATION TABLE
SUPER STUDENT WITH FINANCIAL NEED                                     PAGE  1
******************************************************************************

                              ELIMINATION TABLE

         SUPER STUDENT WITH FINANCIAL NEED


          COLLEGES                   REASONS FOR ELIMINATION
          ----------------           -----------------------

          YALE                       CO-ED LIVING?
          U.D.                       CO-ED LIVING?
          HARVARD                    CO-ED LIVING?


DO YOU WISH TO SEE TABULAR OUTPUT ? (YES/NO)
YES
```

```
******************************************************************************
     COLLEGE EXAMPLE       CASE 1   UTILITY VALUES TABLE
SUPER STUDENT WITH FINANCIAL NEED                                     PAGE  1
******************************************************************************

                         UTILITY VALUES FOR COLLEGE EXAMPLE

                                COLLEGES

                                A -- YALE
                                B -- U.D.
                                C -- HARVARD
                                D -- U.S.C.
                                E -- BERKELY
                                       OPTIMUM
   A       B       C       D       E       COLLEGES

0.000   0.000   0.000    .516    .520         E



DO YOU WISH TO EXECUTE THE PROGRAM AGAIN ? (YES/NO)
NO
```

Figure 20 - Concluded

APPENDIX A - PROGRAM ANALYSIS

The SSMP user selects the parameters and, if desired, parameter limits and parameter ratings. This information is used to determine the best system by mathematically evaluating the parameter datawhich have been weighed by the parameter ratings. The user can specify parameter data limits. If a system and/or subsystem do not satisfy these parameter limits, that system and/or subsystem are eliminated from the decision process.

The program module ELIMIN evaluates the user's parameter choices and limits and eliminates unwanted parameter data and systems and/or subsystems that do not satisfy parameter limits.

The data base PP (parameter package) is set up so that SSMP evaluates the data one parameter at a time and all of the data for the systems or subsystems for that parameter at the same time.

The program module sets up two arrays, ELIM and MATRIX. The array ELIM stores the parameter that eliminated the system or subsystem. This array is used to print out the reasons for elimination of a system or subsystem and is detailed in the elimination table. The array MATRIX stores a zero when a parameter does not satisfy a limit or if a parameter is not chosen to participate in the decision process. If a system and/or subsystem is eliminated, ELIMIN puts zeros in the array MATRIX for that system and/or subsystem parameter data. The SSMP considers zeros in the parameter package (PP) as blanks and does not do any calculations or evaluations for those data.

The program module ELIMIN then calls up TABLE, which prints out the elimination table. Next, the program module INVRT is called to invert any parameter data that do not show the best value as the lowest value. If a parameter value has been indicated as inverted, INVRT reads in that parameter's data. For each line of systems or subsystems, INVRT finds the largest value. The inverted parameter data are determined by the following equation:

$$\text{inverted parameter} = \frac{\text{largest value}}{\text{parameter data}}$$

If the parameter data do not need inverting, they are written out onto the data file VPARM untouched.

SSMP calls the program module UTILT, which determines the best system. The UTILT module first reads in the parameter data from the data file VPARM. Next, it eliminates any parameter data for any eliminated system and/or subsystems by multiplying the PARAM array by the MATRIX array. The zeros in the MATRIX indicate the eliminated systems and/or subsystems. The UTILT module finds the smallest and largest value for each line of parameter data and calculates the utility of each system parameter by the following equation:

$$U_a = \frac{\text{largest value} - \text{current value}}{\text{largest value} - \text{smallest value}}$$

For example, if the parameter values under consideration are 9, 7, 3, 2, 1, and 5, 9 would be the largest value and 1 the smallest. If the system being evaluated has the parameter rating of 3, this would be the current value, and the utility of the parameter for the system under consideration would equal 6/8, or 0.75. This utility value of a specified system is based upon an individual parameter value relative to the parameter ratings of all systems under consideration. If the largest value equals the smallest value, the utility is assigned unity.

To calculate the overall utility for each system, the utility values for each parameter are multiplied by their respective preference ratings, obtained from the UPP file, and the resultant products are summed:

$$U_{sys}=K_1U_1 + K_2U_2 + \ldots + K_nU_n$$

K_a = User's preference rating for each parameter
U_a = Utility value for each parameter

SSMP prints out the results in the utility table.

APPENDIX B - SYSTEM SELECTION MODEL IN BATCH MODE

When a particular problem is too large to be run interactively with the programs described earlier, the problem can be solved by running the programs in batch mode. The batch process submits the job to a system batch queue so that it may be run independently of the user's control. The batch process allows the user to specify whether the job is to be printed, punched, or sent to a remote terminal.

When a program is run interactively the user must input data from the terminal as the program is executing. Batch mode input differs from interactive in that the input data are sent in the batch file, along with the job control cards that execute the program. This makes it possible for the user to perform other tasks while the program is executing.

Setting up a program to run in batch mode is a simple process. The user should take the following steps in preparing and entering the batch file:

a. Determine the dimensions needed for the arrays to allow the program to process the particular size problem. The reader will recall that array dimensions are set to maximum interactive memory limits. A list of the arrays and their dimensions appears in Section II, Table 2. Make the appropriate changes in the source files and recompile the source. For the decision model use SYSSELB and SSMPB as the source file and object file, respectively.

b. The user should next begin to set up the batch file itself. The first card of the file should be the job card. The job card parameters consist of the user's box number, the estimated CPU and I/O times in seconds, and the estimated requirements for core memory in words. The last three parameters must be coded in octal, or base eight, numerals. The specification of these particular parameters is recommended to increase system efficiency and improve job turnaround time. Typical values might be T10, IO50, CM70000, meaning 8 seconds cpu time, 40 seconds I/O time, and 28672 words of memory (all values given in base 10). The next thing to appear on the job card is a period, followed by comments to the operator so that your job may be verified. These consist of the problem number, address and phone number in case a problem should arise. The next cards will ATTACH the data files needed to run the program, and then the object file for the program itself must be ATTACHed. Following the ATTACH cards will be a card containing the object file name followed by a period, used to execute the file. Next in the file appears a *EOR, which separates the job control statements from the data to follow the *EOR. The next set of cards hold the data, which consist of all the responses normally typed by the user during interactive execution. The user should run the program a few times interactively to make certain no responses are left out of the batch file data section. After the data cards are finished, the file is ended with *EOR and *EOF cards.

The following is a review of the basic form of the file:

```
Jobname,Tnn,IOmm,CMxxxxx.problem#,address,phone.
ATTACH, data filename.
ATTACH, data filename.
ATTACH, object filename.
Object filename.
*EOR
All input data, one datum per line.
          .
          .
          .
          .
*EOR
*EOF
```

This file should be saved and made permanent.

(c) The next step is to enter the file into the batch queue. This is accomplished with the BATCH command. Two options exist as to where output from the batch job will be sent, and the user should decide at this point whether or not he wishes hardcopy output that must be obtained at the computer facility. If the user wishes to obtain a hardcopy of his output, the following command should be issued;

```
BATCH, batch filename,INPUT.
```

If the user wishes to obtain his results at a remote terminal, the following command is issued:

```
BATCH, batch filename,INPUT,HERE.
```

When the user issues either of these commands, he has entered his program in batch. The program will remain in the queue until it is executed. If the user has chosen the second form, results may be examined by using the FIND command. Format for the FIND command is as follows:

```
FIND,jobid.
```

where jobid consists of enough characters of the jobname (listed on the jobcard of the batch file) to identify it uniquely. See the NOS/BE 1 Reference Manual for more details.

The file will first appear in the input queue, identified by the five-character jobname plus two system-generated characters, then will enter the execute queue, and eventually will be listed as residing in the output queue, indicating the task is completed. The user may examine his output by first making the file local with another form of the BATCH command:

```
BATCH,output filename,LOCAL.
```

and by using either the PAGE function or the EDITOR program.

APPENDIX C - EXAMPLES

These examples are provided to demonstrate to the user the capabilities of SSMP and the supporting programs' options. Included are several examples which demonstrate exactly how the problem is entered into the model and which provide some insight as to how the structure of a problem is chosen. One example, the generator selection, is an example of a problem which lends itself to a Case 3 type breakdown. The horse example, however, is a good example of a decision which could not logically be broken down further than a Case 1 problem.

Note that, in all the examples, the SSMP may be executed as many times as is desired in order to see how different limitations on the decision process affect the final outcome.

```
**********************************************************************
*                      PARAMETER PACKAGE PROGRAM                     *
**********************************************************************
COMMANDS AVAILABLE:
    CRTE - CPEATES FILE OF NAMES
    MNIN - ALLOWS MANUAL ENTERING OF PARAMETER VALUES
    LIST - LISTS OUT NAMES ANC PARAMETER VALUES
    END  - ENDS PROGRAM
COMMAND-->CRTE
```

```
ENTER DATA BASE NAME (MAX 16 CHARS)
REPORT EXAMPLE
ENTER NO. OF SYSTEMS (2 DIGIT NO.)
04
ENTER NO. OF LEVEL 1 SUBSYSTEMS (2 DIGIT NO.)
00
ENTER NO. OF LEVEL 2 SUBSYSTEMS (2 DIGIT NO.)
00
ENTEP NO. OF PARAMETERS (2 DIGIT NO.)
14
ENTER SYSTEM SETNAME (MAX. 16 CHARS.)
GENERATORS
ENTER NAME FOR GENERATORS       NO.  1 (MAX. 16 CHARS)
GAS TURBINE
ENTER NAME FOR GENERATORS       NO.  2 (MAX. 16 CHARS)
DIESEL
ENTEP NAME FOR GENERATORS       NO.  3 (MAX. 16 CHARS)
FUEL CELL
ENTER NAME FOR GENERATORS       NO.  4 (MAX. 16 CHARS)
STIRLING ENGINE
```

```
ENTER NAME FOR PARAMETER NO. 1
ACQUISITION COST
ENTER NAME FOR PARAMETER NO. 2
LIFE CYCLE COST
ENTER NAME FOR PARAMETER NO. 3
SYSTEM EFF.
ENTER NAME FOR PARAMETER NO. 4
START UP TIME
ENTER NAME FOR PARAMETER NO. 5
SHUTDOWN TIME
ENTER NAME FOR PARAMETER NO. 6
RELIABILITY
ENTER NAME FOR PARAMETER NO. 7
MAINT. AND OPER.
ENTER NAME FOR PARAMETER NO. 8
LIFETIME
ENTER NAME FOR PARAMETER NO. 9
THERMAL ENERGY
ENTER NAME FOR PARAMETER NO.10
VOLUME/SIZE
ENTER NAME FOR PARAMETER NO.11
WEIGHT
ENTER NAME FOR PARAMETER NO.12
FUEL USED
ENTER NAME FOR PARAMETER NO.13
GROWTH POTENTIAL
ENTER NAME FOR PARAMETER NO.14
ENVIRON.CONSTR.
```

```
IS ACQUISITION COST A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR ACQUISITION COST ? (YES/NO)
NO
IS LIFE CYCLE COST  A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR LIFE CYCLE COST  ? (YES/NO)
NO
IS SYSTEM EFF.      A NUMERICAL PARAMETER ? (YES/NO)
NO
IS SYSTEM EFF.      A RATED PARAMETER ? (YES/NO)
YES
IS START UP TIME    A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR START UP TIME    ? (YES/NO)
NO
IS SHUTDOWN TIME    A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR SHUTDOWN TIME    ? (YES/NO)
NO
IS RELIABILITY      A NUMERICAL PARAMETER ? (YES/NO)
NO
IS RELIABILITY      A RATED PARAMETER ? (YES/NO)
YES
IS MAINT. AND OPER. A NUMERICAL PARAMETER ? (YES/NO)
NO
IS MAINT. AND OPER. A RATED PARAMETER ? (YES/NO)
YES
```

```
IS LIFETIME         A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR LIFETIME         ? (YES/NO)
NO
IS THERMAL ENERGY   A NUMERICAL PARAMETER ? (YES/NO)
NO
IS THERMAL ENERGY   A RATED PARAMETER ? (YES/NO)
YES
IS VOLUME/SIZE      A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR VOLUME/SIZE      ? (YES/NO)
NO
IS WEIGHT           A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR WEIGHT           ? (YES/NO)
NO
IS FUEL USED        A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR FUEL USED        ? (YES/NO)
NO
IS GROWTH POTENTIAL A NUMERICAL PARAMETER ? (YES/NO)
NO
IS GROWTH POTENTIAL A RATED PARAMETER ? (YES/NO)
YES
IS ENVIRON.CONSTR.  A NUMERICAL PARAMETER ? (YES/NO)
NO
IS ENVIRON.CONSTR.  A RATED PARAMETER ? (YES/NO)
NO
IS ENVIRON.CONSTR.  A QUALITATIVE PARAMETER ? (YES/NO)
YES
COMMAND-->MNIN
```

```
ACQUISITION COST
THIS IS A NUMERIC PARAMETER - ENTER A NUMBER
GAS TURBINE       -- 2100
DIESEL            -- 2000
FUEL CELL         -- 3000
STIRLING ENGINE   -- 1200
LIFE CYCLE COST
THIS IS A NUMERIC PARAMETER - ENTER A NUMBER
GAS TURBINE       -- 30000
DIESEL            -- 40000
FUEL CELL         -- 23000
STIRLING ENGINE   -- 14000
SYSTEM EFF.
THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR
GAS TURBINE       -- 2
DIESEL            -- 1
FUEL CELL         -- 3
STIRLING ENGINE   -- 1
START UP TIME
THIS IS A NUMERIC PARAMETER - ENTER A NUMBER
GAS TURBINE       -- 24
DIESEL            -- 8
FUEL CELL         -- 48
STIRLING ENGINE   -- 72
SHUTDOWN TIME
THIS IS A NUMERIC PARAMETER - ENTER A NUMBER
GAS TURBINE       -- 12
DIESEL            -- 6
FUEL CELL         -- 2
STIRLING ENGINE   -- 24
```

```
RELIABILITY
THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR
GAS TURBINE        -- 1
DIESEL             -- 2
FUEL CELL          -- 3
STIRLING ENGINE    -- 4
MAINT. AND OPER.
THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR
GAS TURBINE        -- 3
DIESEL             -- 2
FUEL CELL          -- 2
STIRLING ENGINE    -- 1
LIFETIME
THIS IS A NUMERIC PARAMETER - ENTER A NUMBER
GAS TURBINE        -- 100
DIESEL             -- 50
FUEL CELL          -- 23
STIRLING ENGINE    -- 22
THERMAL ENERGY
THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR
GAS TURBINE        -- 3
DIESEL             -- 2
FUEL CELL          -- 2
STIRLING ENGINE    -- 1
VOLUME/SIZE
THIS IS A NUMERIC PARAMETER - ENTER A NUMBER
GAS TURBINE        -- 400
DIESEL             -- 300
FUEL CELL          -- 200
STIRLING ENGINE    -- 450
```

```
WEIGHT
THIS IS A NUMERIC PARAMETER - ENTER A NUMBER
GAS TURBINE       -- 300
DIESEL            -- 340
FUEL CELL         -- 200
STIRLING ENGINE  -- 1200
FUEL USED
THIS IS A NUMERIC PARAMETER - ENTER A NUMBER
GAS TURBINE       -- 34
DIESEL            -- 23
FUEL CELL         -- 67
STIRLING ENGINE  -- 12
GROWTH POTENTIAL
THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD. 3-FAIR, 4-POOR, 5-VERY POOR
GAS TUPBINE       -- 1
DIESEL            -- 2
FUEL CELL         -- 3
STIRLING ENGINE  -- 4
ENVIPON.CONSTR.
THIS IS A QUALITATIVE PARAMETER - ENTER 1 FOP YES, 0 FOR NO
GAS TURBINE       -- 1
DIESEL            -- 1
FUEL CELL         -- 1
STIRLING ENGINE  -- 1
COMMAND-->LIST
```

```
***************************************************************
*                                                             *
*                       ACQUISITION COST                      *
*                                                             *
***************************************************************
*    GAS TURBINE        DIESEL             FUEL CELL          *
*           2100.000           2000.000           3000.000    *
*                                                             *
*                       STIRLING ENGINE                       *
*                              1200.000                       *
*                                                             *
***************************************************************
```

```
***************************************************************
*                                                             *
*                       LIFE CYCLE COST                       *
*                                                             *
***************************************************************
*    GAS TURBINE        DIESEL             FUEL CELL          *
*          30000.000          40000.000          23000.000    *
*                                                             *
*                       STIRLING ENGINE                       *
*                             14000.000                       *
*                                                             *
***************************************************************
```

```
***************************************************************
*                                                             *
*                       SYSTEM EFF.                           *
*                                                             *
***************************************************************
*    GAS TURBINE        DIESEL             FUEL CELL          *
*      GOOD               EXCELLENT          FAIR             *
*                                                             *
*                       STIRLING ENGINE                       *
*                         EXCELLENT                           *
*                                                             *
***************************************************************
```

```
*****************************************************************
*                                                               *
*                        START UP TIME                          *
*                                                               *
*****************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL          *
*              24.000              8.000               48.000   *
*                                                               *
*                        STIRLING ENGINE                        *
*                                  72.000                       *
*                                                               *
*****************************************************************
```

```
*****************************************************************
*                                                               *
*                        SHUTDOWN TIME                          *
*                                                               *
*****************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL          *
*              12.000              6.000                2.000   *
*                                                               *
*                        STIRLING ENGINE                        *
*                                  24.000                       *
*                                                               *
*****************************************************************
```

```
*****************************************************************
*                                                               *
*                        RELIABILITY                            *
*                                                               *
*****************************************************************
*    GAS TURBINE         DIESEL              FUEL CELL          *
*      EXCELLENT           GOOD                FAIR             *
*                                                               *
*                        STIRLING ENGINE                        *
*                          POOR                                 *
*                                                               *
*****************************************************************
```

```
*******************************************************************
*                                                                 *
*                        MAINT. AND OPER.                         *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL                FUEL CELL         *
*       FAIR                GOOD                  GOOD            *
*                                                                 *
*                        STIRLING ENGINE                          *
*                          EXCELLENT                              *
*                                                                 *
*******************************************************************
```

```
*******************************************************************
*                                                                 *
*                        LIFETIME                                 *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL                FUEL CELL         *
*            100.000                50.000               23.000   *
*                                                                 *
*                        STIRLING ENGINE                          *
*                                   22.000                        *
*                                                                 *
*******************************************************************
```

```
*******************************************************************
*                                                                 *
*                        THERMAL ENERGY                           *
*                                                                 *
*******************************************************************
*     GAS TURBINE         DIESEL                FUEL CELL         *
*       FAIR                GOOD                  GOOD            *
*                                                                 *
*                        STIRLING ENGINE                          *
*                          EXCELLENT                              *
*                                                                 *
*******************************************************************
```

```
***********************************************************************
*                                                                     *
*                          VOLUME/SIZE                                *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*              400.000              300.000              200.000      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                   450.000                           *
*                                                                     *
***********************************************************************
```

```
***********************************************************************
*                                                                     *
*                          WEIGHT                                     *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*              300.000              340.000              200.000      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                  1200.000                           *
*                                                                     *
***********************************************************************
```

```
***********************************************************************
*                                                                     *
*                          FUEL USED                                  *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL               FUEL CELL             *
*               34.000               23.000               67.000      *
*                                                                     *
*                          STIRLING ENGINE                            *
*                                    12.000                           *
*                                                                     *
***********************************************************************
```

```
***********************************************************************
*                                                                     *
*                          GROWTH POTENTIAL                           *
*                                                                     *
***********************************************************************
*     GAS TUPBINE          DIESEL                FUEL CELL            *
*       EXCELLENT            GOOD                  FAIR               *
*                                                                     *
*                          STIRLING ENGINE                            *
*                            POOR                                     *
*                                                                     *
***********************************************************************
```

```
***********************************************************************
*                                                                     *
*                          ENVIRON.CONSTR.                            *
*                                                                     *
***********************************************************************
*     GAS TURBINE          DIESEL                FUEL CELL            *
*           YES                  YES                   YES            *
*                                                                     *
*                          STIRLING ENGINE                            *
*                          YES
*                                                                     *
***********************************************************************

COMMAND-->END
```

```
************************************************************************
                        USER'S PREFERENCE PACKAGE PROGRAM
************************************************************************

NOTE: THE COMMANDS CRTE & ADD CAN BE ISSUED ONLY ONCE DURING
A SESSION & YOU CANNOT ISSUE A LIST BEFORE YOU CREATE THAT FILE


COMMAND-->CRTE
ENTER NO. OF SCENARIOS
03
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 1
CONUS
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 2
OVERSEAS
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 3
REMOTE
DO YOU WISH TO SKIP THE PAIRED COMPARSION ? (YES/NO)
YES





          CONUS
ACQUISITION COST
.450
LIFE CYCLE COST
.340
SYSTEM EFF.
.560
START UP TIME
.780
SHUTDOWN TIME
.900
RELIABILITY
.450
MAINT. AND OPER.
.560
LIFETIME
.120
THERMAL ENERGY
.890
VOLUME/SIZE
.600
WEIGHT
.340
FUEL USED
.780
GROWTH POTENTIAL
.560
ENVIRON.CONSTR.
.340
```

```
          OVERSEAS
ACQUISITION COST
.340
LIFE CYCLE COST
.450
SYSTEM EFF.
.890
START UP TIME
.990
SHUTDOWN TIME
.450
RELIABILITY
.120
MAINT. AND OPER.
.780
LIFETIME
.560
THERMAL ENERGY
.230
VOLUME/SIZE
.790
WEIGHT
.450
FUEL USED
.780
GROWTH POTENTIAL
.770
ENVIRON.CONSTR.
.500
```

```
         REMOTE
ACQUISITION COST
.450
LIFE CYCLE COST
.770
SYSTEM EFF.
.220
START UP TIME
.100
SHUTDOWN TIME
.600
RELIABILITY
.450
MAINT. AND OPER.
.300
LIFETIME
.900
THERMAL ENERGY
.300
VOLUME/SIZE
.600
WEIGHT
.600
FUEL USED
.900
GROWTH POTENTIAL
.100
ENVIRON.CONSTR.
.570
COMMAND-->LIST
```

```
*********************************************************************
REPORT EXAMPLE       CASE 1   USER'S PREFERENCE PACKAGE
CONUS                                                         PAGE  1
*********************************************************************

                    ACQUISITION COST      .450

                    LIFE CYCLE COST       .340

                    SYSTEM EFF.           .560

                    START UP TIME         .760

                    SHUTDOWN TIME         .900

                    RELIABILITY           .450

                    MAINT. AND OPER.      .560

                    LIFETIME              .120

                    THERMAL ENERGY        .990

                    VOLUME/SIZE           .600

                    WEIGHT                .340

                    FUEL USED             .760

                    GROWTH POTENTIAL      .560

                    ENVIRON.CONSTR.       .340
```

```
***********************************************************************
REPORT EXAMPLE        CASE 1   USER'S PREFERENCE PACKAGE
OVERSEAS                                                        PAGE  2
***********************************************************************

                    ACQUISITION COST       .340

                    LIFE CYCLE COST        .450

                    SYSTEM EFF.            .890

                    START UP TIME          .990

                    SHUTDOWN TIME          .450

                    RELIABILITY            .120

                    MAINT. AND OPER.       .780

                    LIFETIME               .560

                    THERMAL ENERGY         .230

                    VOLUME/SIZE            .790

                    WEIGHT                 .450

                    FUEL USED              .780

                    GROWTH POTENTIAL       .770

                    ENVIRON.CONSTP.        .500
```

```
******************************************************************
REPORT EXAMPLE        CASE 1   USER'S PREFERENCE PACKAGE
REMOTE                                                     PAGE  3
******************************************************************

                  ACQUISITION COST       .450

                  LIFE CYCLE COST        .770

                  SYSTEM EFF.            .220

                  START UP TIME          .100

                  SHUTDOWN TIME          .600

                  RELIABILITY            .450

                  MAINT. AND OPER.       .300

                  LIFETIME               .900

                  THERMAL ENERGY         .300

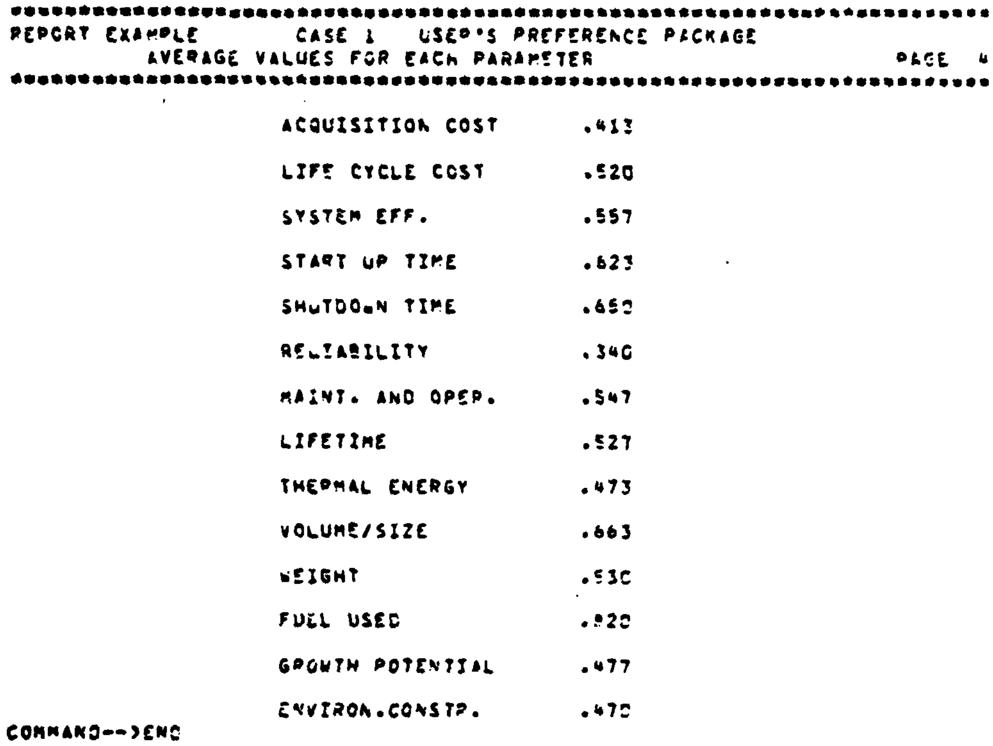
                  VOLUME/SIZE            .600

                  WEIGHT                 .800

                  FUEL USED              .900

                  GROWTH POTENTIAL       .100

                  ENVIRON.CONSTR.        .570
```



```
***********************************************************************
REPORT EXAMPLE        CASE 1   USER'S PREFERENCE PACKAGE
          AVERAGE VALUES FOR EACH PARAMETER                     PAGE  4
***********************************************************************

                    ACQUISITION COST       .413

                    LIFE CYCLE COST        .520

                    SYSTEM EFF.            .557

                    START UP TIME          .623

                    SHUTDOWN TIME          .650

                    RELIABILITY            .340

                    MAINT. AND OPER.       .547

                    LIFETIME               .527

                    THERMAL ENERGY         .473

                    VOLUME/SIZE            .663

                    WEIGHT                 .530

                    FUEL USED              .820

                    GROWTH POTENTIAL       .477

                    ENVIRON.CONSTR.        .470
COMMAND-->END
```

```
************************************************************************

                    SYSTEM SELECTION MODEL PROGRAM

************************************************************************


LIST OF AVAILABLE PARAMETERS


 1 -- ACQUISITION COST
 2 -- LIFE CYCLE COST
 3 -- SYSTEM EFF.
 4 -- START UP TIME
 5 -- SHUTDOWN TIME
 6 -- RELIABILITY
 7 -- MAINT. AND OPER.
 8 -- LIFETIME
 9 -- THERMAL ENERGY
10 -- VOLUME/SIZE
11 -- WEIGHT
12 -- FUEL USED
13 -- GROWTH POTENTIAL
14 -- ENVIRON.CONSTR.









DO YOU WISH TO ENTER YOUR OWN RATINGS ? (YES/NO)
NO


SCENARIOS AVAILABLE

      1 -- CONUS
      2 -- OVERSEAS
      3 -- REMOTE


ENTEP NO OF CHOICE OF SCENARIO
2
```

```
OVERSEAS

         ****************************************
         *          PARAMETERS         * RATINGS *
         ****************************************
         *      ACQUISITION COST       *   .400  *
         *      LIFE CYCLE COST        *   .780  *
         *      SYSTEM EFF.            *   .110  *
         *      START UP TIME          *   .770  *
         *      SHUTDOWN TIME          *   .450  *
         *      RELIABILITY            *   .800  *
         *      MAINT. AND OPER.       *   .780  *
         *      LIFETIME               *   .450  *
         *      THERMAL ENERGY         *   .560  *
         *      VOLUME/SIZE            *   .500  *
         *      WEIGHT                 *   .780  *
         *      FUEL USED              *   .760  *
         *      GROWTH POTENTIAL       *   .430  *
         *      ENVIRON.CONSTR.        *   .670  *
         ****************************************
```

```
14
ENTER THE NUMBER OF PARAMETERS TO BE INCLUDED IN THE DECISION PROCESS


ENTER EACH INTEGER NO. ASSOCIATED WITH EACH CHOSEN
PARAMETER (FROM LOWEST TO HIGHEST)

 PARAMETER NO. --  1
 PARAMETER NO. --  2
 PARAMETER NO. --  3
 PARAMETER NO. --  4
 PARAMETER NO. --  5
 PARAMETER NO. --  6
 PARAMETER NO. --  7
 PARAMETER NO. --  8
 PARAMETER NO. --  9
 PARAMETER NO. -- 10
 PARAMETER NO. -- 11
 PARAMETER NO. -- 12
 PARAMETER NO. -- 13
 PARAMETER NO. -- 14
PARAMETER -- ACQUISITION COST
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- LIFE CYCLE COST
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- SYSTEM EFF.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- START UP TIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- SHUTDOWN TIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- RELIABILITY
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO
```

```
PARAMETER -- MAINT. AND OPER.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- LIFETIME
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- THERMAL ENERGY
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- VOLUME/SIZE
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO
```

```
PARAMETER -- WEIGHT
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- FUEL USED
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- GROWTH POTENTIAL
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- ENVIRON.CONSTR.
A QUALATITIVE PARAMETER--CANNOT SPECIFY A RANGE

DO YOU WISH TO SEE TABULAR OUTPUT ? (YES/NO)
YES









*************************************************************************
      REPORT EXAMPLE        CASE 1    UTILITY VALUES TABLE
OVERSEAS                                                         PAGE  1
*************************************************************************


                         UTILITY VALUES FOR REPORT EXAMPLE

                                  GENERATORS

                                  A -- GAS TURBINE
                                  B -- DIESEL
                                  C -- FUEL CELL
                                  D -- STIRLING ENGINE
                                   OPTIMUM
    A       B       C       D      GENERATORS

 .635    .687    .574    .547          B



DO YOU WISH TO EXECUTE THE PROGRAM AGAIN ? (YES/NO)
NO
```

```
**********************************************************************
*                         PARAMETER PACKAGE PROGRAM                  *
**********************************************************************


COMMANDS AVAILABLE:
    CRTE - CREATES FILE OF NAMES
    MNIN - ALLOWS MANUAL ENTERING OF PARAMETER VALUES
    LIST - LISTS OUT NAMES AND PARAMETER VALUES
    END  - ENDS PROGRAM


COMMAND-->CRTE









ENTER DATA BASE NAME (MAX 16 CHARS)
REPORT EXAMPLE
ENTER NO. OF SYSTEMS (2 DIGIT NO.)
05
ENTER NO. OF LEVEL 1 SUBSYSTEMS (2 DIGIT NO.)
00
ENTER NO. OF LEVEL 2 SUBSYSTEMS (2 DIGIT NO.)
00
ENTER NO. OF PARAMETERS (2 DIGIT NO.)
06
ENTER SYSTEM SETNAME (MAX. 16 CHARS.)
HORSES
ENTER NAME FOR HORSES           NO.  1 (MAX. 16 CHARS)
LUCKY STRIKER
ENTER NAME FOR HORSES           NO.  2 (MAX. 16 CHARS)
MAN OF WAR
ENTER NAME FOR HORSES           NO.  3 (MAX. 16 CHARS)
ENTERPRISE
ENTER NAME FOR HORSES           NO.  4 (MAX. 16 CHARS)
THE SEEKER
ENTER NAME FOR HORSES           NO.  5 (MAX. 16 CHARS)
ALEX THE GREAT
```

```
ENTER NAME FOR PARAMETER NO. 1
SPEED
ENTER NAME FOR PARAMETER NO. 2
GATE START
ENTER NAME FOR PARAMETER NO. 3
BACKGROUND
ENTER NAME FOR PARAMETER NO. 4
PREV. REC.
ENTER NAME FOR PARAMETER NO. 5
FIRST RACE?
ENTER NAME FOR PARAMETER NO. 6
LUCK
```

```
IS SPEED            A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR SPEED             ? (YES/NO)
NO
IS GATE START       A NUMERICAL PARAMETER ? (YES/NO)
YES
FOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS
CONSIDERED THE "BEST" VALUE.
 DO YOU WISH TO INVERT THIS FOR GATE START        ? (YES/NO)
NO
IS BACKGROUND       A NUMERICAL PARAMETER ? (YES/NO)
NO
IS BACKGROUND       A RATED PARAMETER ? (YES/NO)
YES
IS PREV.REC         A NUMERICAL PARAMETER ? (YES/NO)
NO
IS PREV.REC         A RATED PARAMETER ? (YES/NO)
YES
IS FIRST RACE?      A NUMERICAL PARAMETER ? (YES/NO)
NO
IS FIRST RACE?      A RATED PARAMETER ? (YES/NO)
NO
IS FIRST RACE?      A QUALITATIVE PARAMETER ? (YES/NO)
YES
IS LUCK             A NUMERICAL PARAMETER ? (YES/NO)
NO
IS LUCK             A RATED PARAMETER ? (YES/NO)
YES
COMMAND-->MNIN
```

```
SPEED

THIS IS A NUMERIC PARAMETER - ENTER A NUMBER

LUCKY STRIKER     -- 200
MAN OF WAR        -- 244
ENTERPRISE        -- 300
THE SEEKER        -- 201
ALEX THE GREAT    -- 190
GATE START

THIS IS A NUMERIC PARAMETER - ENTER A NUMBER

LUCKY STRIKER     -- 2
MAN OF WAR        -- 3
ENTERPRISE        -- 4
THE SEEKER        -- 1
ALEX THE GREAT    -- 5
BACKGROUND

THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR

LUCKY STRIKER     -- 2
MAN OF WAR        -- 3
ENTERPRISE        -- 2
THE SEEKER        -- 1
ALEX THE GREAT    -- 2
PREV.REC

THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR

LUCKY STRIKER     -- 1
MAN OF WAR        -- 2
ENTERPRISE        -- 2
THE SEEKER        -- 3
ALEX THE GREAT    -- 1




FIRST PACE?

THIS IS A QUALITATIVE PARAMETER - ENTER 1 FOR YES, 0 FOR NO

LUCKY STRIKER     -- 1
MAN OF WAR        -- 1
ENTERPRISE        -- 1
THE SEEKER        -- 1
ALEX THE GREAT    -- 1
LUCK

THIS IS A RATED PARAMETER - RATE AS FOLLOWS:
1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR

LUCKY STRIKER     -- 3
MAN OF WAR        -- 2
ENTERPRISE        -- 2
THE SEEKER        -- 1
ALEX THE GREAT    -- 4
COMMAND-->LIST
```

```
**************************************************************
*                                                            *
*                       SPEED                                *
*                                                            *
**************************************************************
*    LUCKY STRIKER     MAN OF WAR         ENTERPRISE         *
*           200.000           244.000            300.000    *
*                                                            *
*          THE SEEKER               ALEX THE GREAT           *
*                  201.000                  190.000          *
*                                                            *
**************************************************************
```

```
**************************************************************
*                                                            *
*                       GATE START                           *
*                                                            *
**************************************************************
*    LUCKY STRIKER     MAN OF WAR         ENTERPRISE         *
*              2.000             3.000              4.000    *
*                                                            *
*          THE SEEKER               ALEX THE GREAT           *
*                    1.000                   5.000           *
*                                                            *
**************************************************************
```

```
**************************************************************
*                                                            *
*                      BACKGROUND                            *
*                                                            *
**************************************************************
*    LUCKY STRIKER     MAN OF WAR         ENTERPRISE         *
*      GOOD              FAIR               GOOD             *
*                                                            *
*          THE SEEKER               ALEX THE GREAT           *
*            EXCELLENT               GOOD                    *
*                                                            *
**************************************************************
```

```
********************************************************************
*                                                                  *
*                             PREV.REC                             *
*                                                                  *
********************************************************************
*     LUCKY STRIKER        MAN OF WAR           ENTERPRISE         *
*       EXCELLENT             GOOD                 GOOD            *
*                                                                  *
*            THE SEEKER                   ALEX THE GREAT           *
*              FAIR                         EXCELLENT              *
*                                                                  *
********************************************************************



********************************************************************
*                                                                  *
*                            FIRST RACE?                           *
*                                                                  *
********************************************************************
*     LUCKY STRIKER        MAN OF WAR           ENTERPRISE         *
*           YES                  YES                  YES          *
*                                                                  *
*            THE SEEKER                   ALEX THE GREAT           *
*                  YES                          YES                *
*                                                                  *
********************************************************************



********************************************************************
*                                                                  *
*                              LUCK                                *
*                                                                  *
********************************************************************
*     LUCKY STRIKER        MAN OF WAR           ENTERPRISE         *
*       FAIR                  GOOD                 GOOD            *
*                                                                  *
*            THE SEEKER                   ALEX THE GREAT           *
*              EXCELLENT                    POOR                   *
*                                                                  *
********************************************************************
COMMAND-->END
```

```
*****************************************************************************
                       USER'S PREFERENCE PACKAGE PROGRAM
*****************************************************************************


NOTE: THE COMMANDS CRTE & ADD CAN BE ISSUED ONLY ONCE DURING
A SESSION & YOU CANNOT ISSUE A LIST BEFORE YOU CREATE THAT FILE


COMMAND-->CRTE
ENTER NO. OF SCENARIOS
02
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 1
FAST HORSE
ENTER SCENARIO DESCRIPTION FOR SCENARIO NO. 2
LONG DISTANCE HORSE
DO YOU WISH TO SKIP THE PAIRED COMPARSION ? (YES/NO)
YES








          FAST HORSE
SPEED
.990
GATE START
.560
BACKGROUND
.230
PREV.REC.
.670
FIRST RACE?
.550
LUCK
.990








          LONG DISTANCE HORSE
SPEED
.665
GATE START
.535
BACKGROUND
.560
PREV.REC.
.830
FIRST RACE?
.665
LUCK
.885
COMMAND-->LIST
```

```
*****************************************************************************
REPORT EXAMPLE        CASE 1   USER'S PREFERENCE PACKAGE
FAST HORSE                                                           PAGE   1
*****************************************************************************

                     SPEED                   .990

                     GATE START              .560

                     BACKGROUND              .230

                     PREV.REC.               .670

                     FIRST RACE?             .550

                     LUCK                    .990
```

```
*****************************************************************************
REPORT EXAMPLE        CASE 1   USER'S PREFERENCE PACKAGE
LONG DISTANCE HORSE                                                  PAGE   2
*****************************************************************************

                     SPEED                   .340

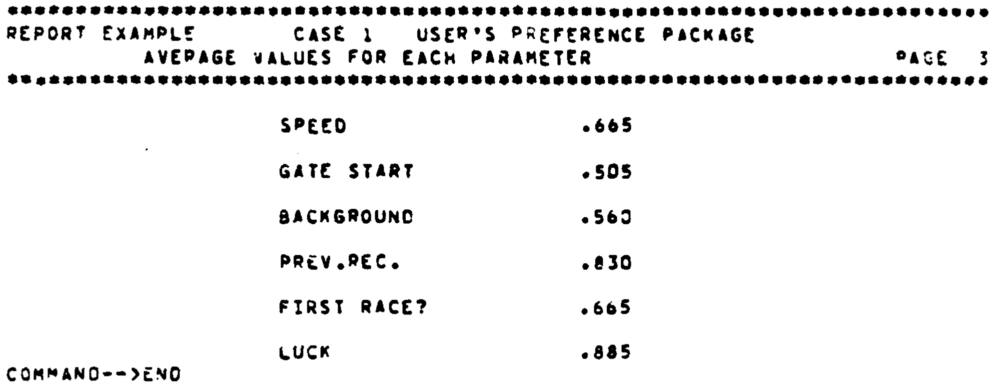
                     GATE START              .450

                     BACKGROUND              .890

                     PREV.REC.               .990

                     FIRST RACE?             .780

                     LUCK                    .780
```



```
***********************************************************************
REPORT EXAMPLE        CASE 1   USER'S PREFERENCE PACKAGE
         AVEPAGE VALUES FOR EACH PARAMETER                        PAGE  3
***********************************************************************

                   SPEED                   .665

                   GATE START              .505

                   BACKGROUND              .560

                   PREV.REC.               .830

                   FIRST RACE?             .665

                   LUCK                    .885
COMMAND-->END
```

```
*************************************************************************

                   SYSTEM SELECTION MODEL PROGRAM

*************************************************************************

LIST OF AVAILABLE PARAMETERS


 1 -- SPEED
 2 -- GATE START
 3 -- BACKGROUND
 4 -- PREV.REC.
 5 -- FIRST RACE?
 6 -- LUCK









DO YOU WISH TO ENTER YOUR OWN RATINGS ? (YES/NO)
NO


SCENARIOS AVAILABLE

      1 -- FAST HORSE
      2 -- LONG DISTANCE HORSE


ENTER NO OF CHOICE OF SCENARIO
2










              LONG DISTANCE HORSE

                    ***************************************
                    *        PARAMETERS         * RATINGS *
                    ***************************************
                    *     SPEED                 *   .340  *
                    *     GATE START            *   .450  *
                    *     BACKGROUND            *   .890  *
                    *     PREV.REC.             *   .990  *
                    *     FIRST RACE?           *   .780  *
                    *     LUCK                  *   .780  *
                    ***************************************
```

```
ENTER THE NUMBER OF PARAMETERS TO BE INCLUDED IN THE DECISION PROCESS
6

ENTER EACH INTEGER NO. ASSOCIATED WITH EACH CHOSEN
PARAMETER (FROM LOWEST TO HIGHEST)

 PARAMETER NO. --  1
 PARAMETER NO. --  2
 PARAMETER NO. --  3
 PARAMETER NO. --  4
 PARAMETER NO. --  5
 PARAMETER NO. --  6








PARAMETER -- SPEED
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- GATE START
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- BACKGROUND
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- PREV.REC.
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO

PARAMETER -- FIRST RACE?
A QUALATITIVE PARAMETER--CANNOT SPECIFY A RANGE

PARAMETER -- LUCK
WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER
HAS TO SATISFY ? (YES/NO)
NO


DO YOU WISH TO SEE TABULAR OUTPUT ? (YES/NO)
YES
```

```
************************************************************************
     REPORT EXAMPLE       CASE 1   UTILITY VALUES TABLE
LONG DISTANCE HORSE                                              PAGE   1
************************************************************************


                       UTILITY VALUES FOR REPORT EXAMPLE

                              HORSES

                              A -- LUCKY STRIKER
                              B -- MAN OF WAR
                              C -- ENTERPRISE
                              D -- THE SEEKER
                              E -- ALEX THE GREAT
                                      OPTIMUM
   A      B      C      D      E      HORSES

 .738   .518   .556   .758   .604        D



DO YOU WISH TO EXECUTE THE PROGRAM AGAIN ? (YES/NO)
NO
```

APPENDIX D - UPPP FLOWCHART AND NARRATIVE

UPPP, the User's Preference Package Program, creates the User's Preference Package (UPP) file, the file containing the set of scenarios and their associated sets of parameter preference ratings. The program uses the HEADER file, created by PPP, to present the parameters to the user and allow the user to rate them, and then incorporates the data into a revised HEADER file and a file named UPP. Appendix D consists of a general flowchart and narrative for the UPPP.

Chart Number 1
Module Name USERS

1.1 USERS creates the user's preference package, which includes scenarios and the parameter ratings for these scenarios.

1.2-1.3 Read in HEADER file.

1.4 Take command from user--CRTE, LIST, ADD, or END.

1.5-1.6 If command is END, stop execution.

1.7-1.8 If command is CRTE, call subroutine CREATE.

1.9-1.10 If command is not CRTE and ITERN = 0 (indicating this is the first run on an already-existing user's preference package), call READR2 to read in the second part of HEADER and UPP.

1.11-1.12 Command ADD calls subroutine ADD to add scenarios.

1.13-1.14 Command LIST causes calling of subroutine LIST, to list scenarios and their associated ratings.

1.15 Read next command.

1.16 Set ITERN = 1 to indicate command sequence has been executed at least once, and return to process new command.

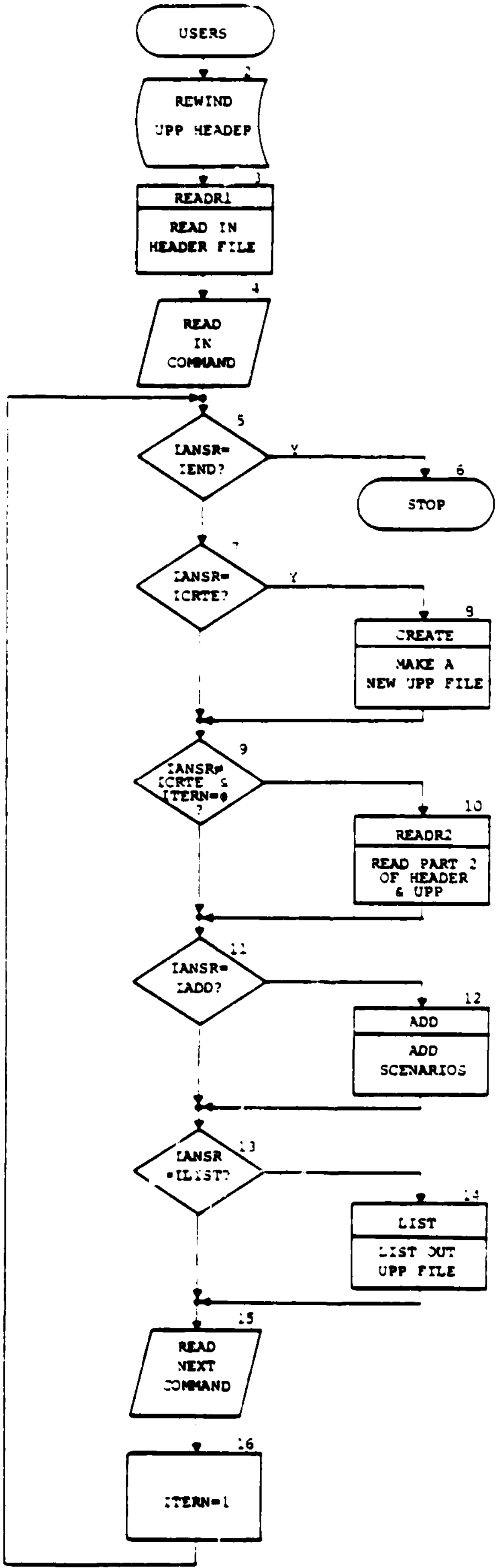

USERS
2
REWIND
UPP HEADER
3
READR1
READ IN
HEADER FILE
4
READ
IN
COMMAND
5
IANSR=
IEND?
Y
6
STOP
7
IANSR=
ICRTE?
Y
8
CREATE
MAKE A
NEW UPP FILE
9
IANSR≠
ICRTE &
ITERN=0
?
10
READR2
READ PART 2
OF HEADER
& UPP
11
IANSR=
IADD?
12
ADD
ADD
SCENARIOS
13
IANSR
=ILIST?
14
LIST
LIST OUT
UPP FILE
15
READ
NEXT
COMMAND
16
ITERN=1

Chart Number 1.3
Module Name USERS

1.3.1 READR1 reads in first part of HEADER file.

1.3.2-1.3.4 Rewind, read problem size and names of systems, subsystems, etc.

1.3.5 Return to main.

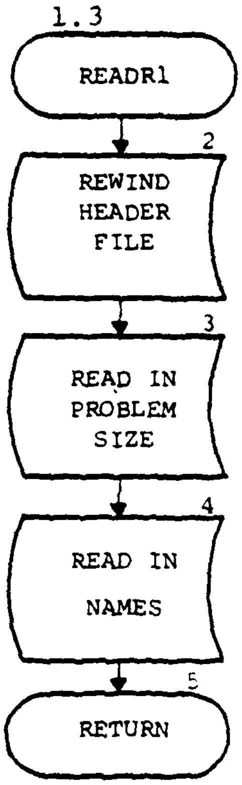

1.3
READR1
2
REWIND HEADER FILE
3
READ IN PROBLEM SIZE
4
READ IN NAMES
5
RETURN

Chart Number 1.8
Module Name USERS

1.8.1 CReaTE creates a User's Preference ?ackage, adding scenarios and ratings to the problem.

1.8.2-1.8.3 Read number of scenarios and their names, or descriptions.

1.8.4 Write out to new HEADER file with WRTR.

1.8.5 Call COMPAR to allow user to enter ratings.

1.8.6 Return to main.

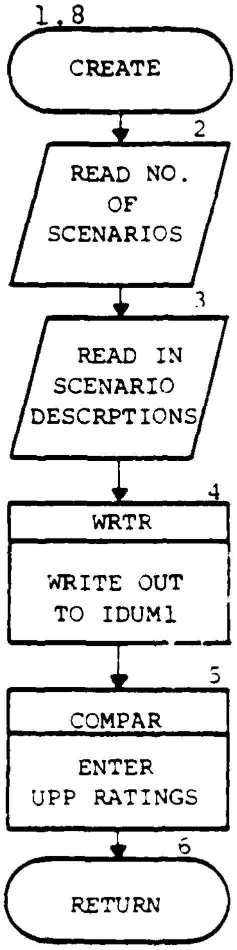

1,8
CREATE
2
READ NO. OF SCENARIOS
3
READ IN SCENARIO DESCRPTIONS
4
WRTR
WRITE OUT TO IDUM1
5
COMPAR
ENTER UPP RATINGS
6
RETURN

Chart Number 1.4
Module Name USERS

1.8.4.1 WRTR writes HEADER's data and any scenario data to file IDUM1, which becomes the new header file.

1.8.4.2-1.8.4.3 Rewind IDUM1 and fill with HEADER information.

1.8.4.4 Return to ADD.

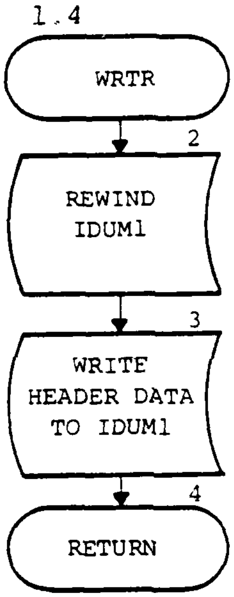

1.4
WRTR
2
REWIND IDUM1
3
WRITE HEADER DATA TO IDUM1
4
RETURN

Chart Number 1.8.5
Module Name USERS

1.8.5.1 COMPAR allows entering of ratings, and writes them to UPP file.

1.8.5.2 User is asked if he wishes to skip the paired comparison.

1.8.5.3 Parameters are presented in pairs; user picks most important.

1.8.5.4 LARGE puts parameters in order after they are compared, from most-chosen to least.

1.8.5.5 The parameters are presented in descending importance order.

1.8.5.6-1.8.4.7 User enters ratings and they are written to the UPP file.

1.8.5.8 Return to subroutine CREATE.

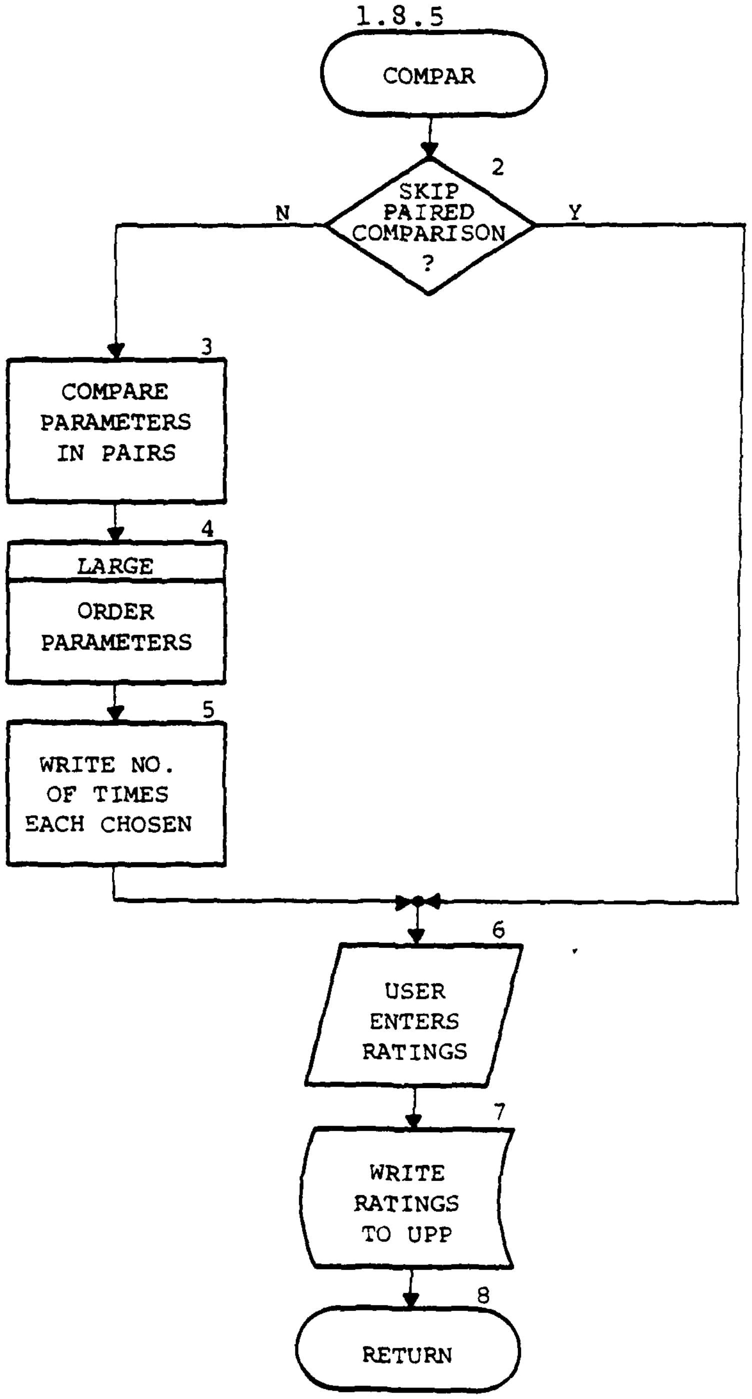

1.8.5
COMPAR
2
SKIP PAIRED COMPARISON ?
N
Y
3
COMPARE PARAMETERS IN PAIRS
4
LARGE
ORDER PARAMETERS
5
WRITE NO. OF TIMES EACH CHOSEN
6
USER ENTERS RATINGS
7
WRITE RATINGS TO UPP
8
RETURN

Chart Number 1.8.5.4
Module Name USERS

1.8.5.4.1 LARGE sorts parameters by numbers of times chosen in the paired comparison and saves the sort order by saving the subscripts of the array elements in another array.

1.8.5.4.2 Determine order by a comparison sort, comparing current element to relative maximum.

1.8.5.4.3 Save sort order, not by changing elements themselves but by saving the subscripts in array IORDER.

1.8.5.4.4 Return to COMPAR.

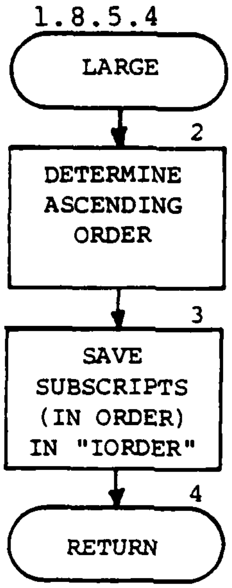

1.8.5.4
LARGE
2
DETERMINE ASCENDING ORDER
3
SAVE SUBSCRIPTS (IN ORDER) IN "IORDER"
4
RETURN

Chart Number 1.10
Module Name USERS

1.10.1 READR2 reads the second part of HEADER and the UPP file; used as a result of executing USERS to ADD to or LIST an already-existing user's preference package.

1.10.2 Read NSCEN, the number of scenarios, from HEADER file.

1.10.3 Read scenario descriptions from HEADER.

1.10.4 Read in ratings from UPP file.

1.10.5 Return to main.

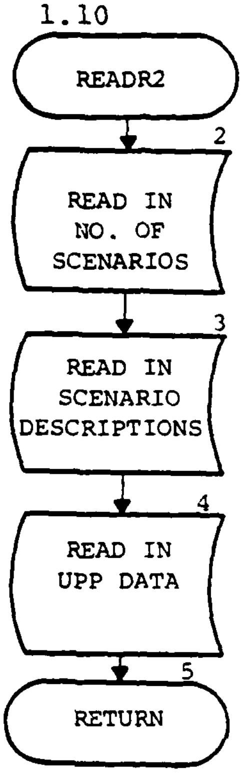

1.10
READR2
2
READ IN NO. OF SCENARIOS
3
READ IN SCENARIO DESCRIPTIONS
4
READ IN UPP DATA
5
RETURN

Chart Number 1.12
Module Name USERS

1.12.1 ADD is called when the users wi3h to add more scenarios to the problem.

1.12.2-1.12.3 Read number of scenarios to add and their descriptions, or names.

1.12.4 Call WRTR to write this new information in the HEADER file. See Chart 1.8.4 for further documentation.

1.12.5 Call COMPAR to allow user to enter ratings. See Chart 1.8.4 for further documentation.

1.12.6 Return to main program.

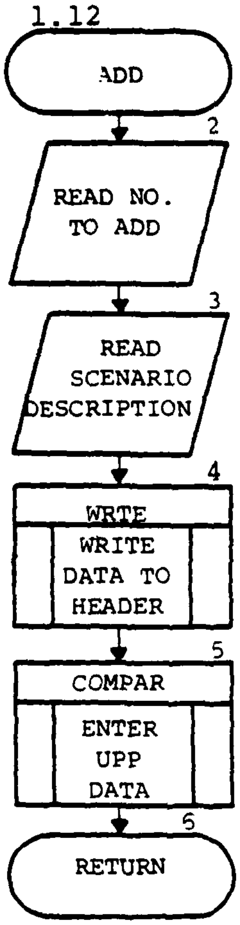

1.12
ADD
2
READ NO. TO ADD
3
READ SCENARIO DESCRIPTION
4
WRTE
WRITE DATA TO HEADER
5
COMPAR
ENTER UPP DATA
6
RETURN

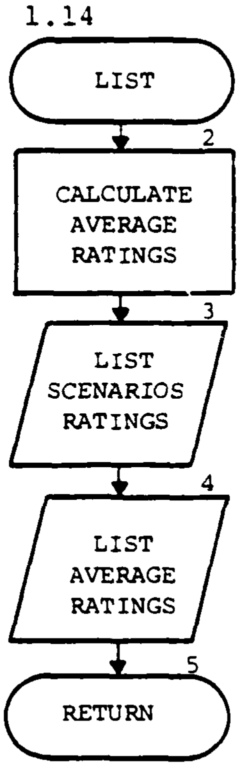
Chart Number 1.14
Module Name USERS

1.14.1 LIST lists out the user's preference package, scenarios, ratings, and average ratings for each parameter.

1.14.2 Calculate average parameter ratings over all scenarios.

1.14.3-1.14.4 List out ratings, for each scenario as well as averaged ratings for all scenarios.

1.14.5 Return to main.


1.14
LIST
2
CALCULATE AVERAGE RATINGS
3
LIST SCENARIOS RATINGS
4
LIST AVERAGE RATINGS
5
RETURN

APPENDIX E - PPP FLOWCHART AND NARRATIVE

PPP, the Parameter Package Program, creates the Parameter Package, which consists of the PP and HEADER data files. The HEADER file contains the size of the problem and the names given to the various entities in the problem, such as the systems, subsystems, parameters, etc. The PP file contains numerical values for the parameters, either coded qualitative values (1 meaning yes, 2 meaning no) or actual numerical data (6875 gallons of fuel usage per year). PPP is the first program in the series comprising the model, and Appendix E consists of a general flowchart and narrative for the program.

Chart No. 1
Module Name PPP

(1) Parameter Package Program

This module reads the user's command and calls the appropriate subroutines.

.1 PAGER clears screen on TEKTRONIX terminal, returns cursor to home.

.2 Print instructions, list and describe commands.

.3 Read in IANSR command string.

.4 End program if "END" is typed.

.5-.6 Create new HEADER file with subroutine CREATE if "CRTE".

.7-.8 Rewind and read in HEADER.

.9-.10 Create PP file if "MNIN" is typed in using subroutine MANUAL.

.11-.12 If "LIST" is typed, call LIST to output HEADER and PP.

.13 Read in new command and return.

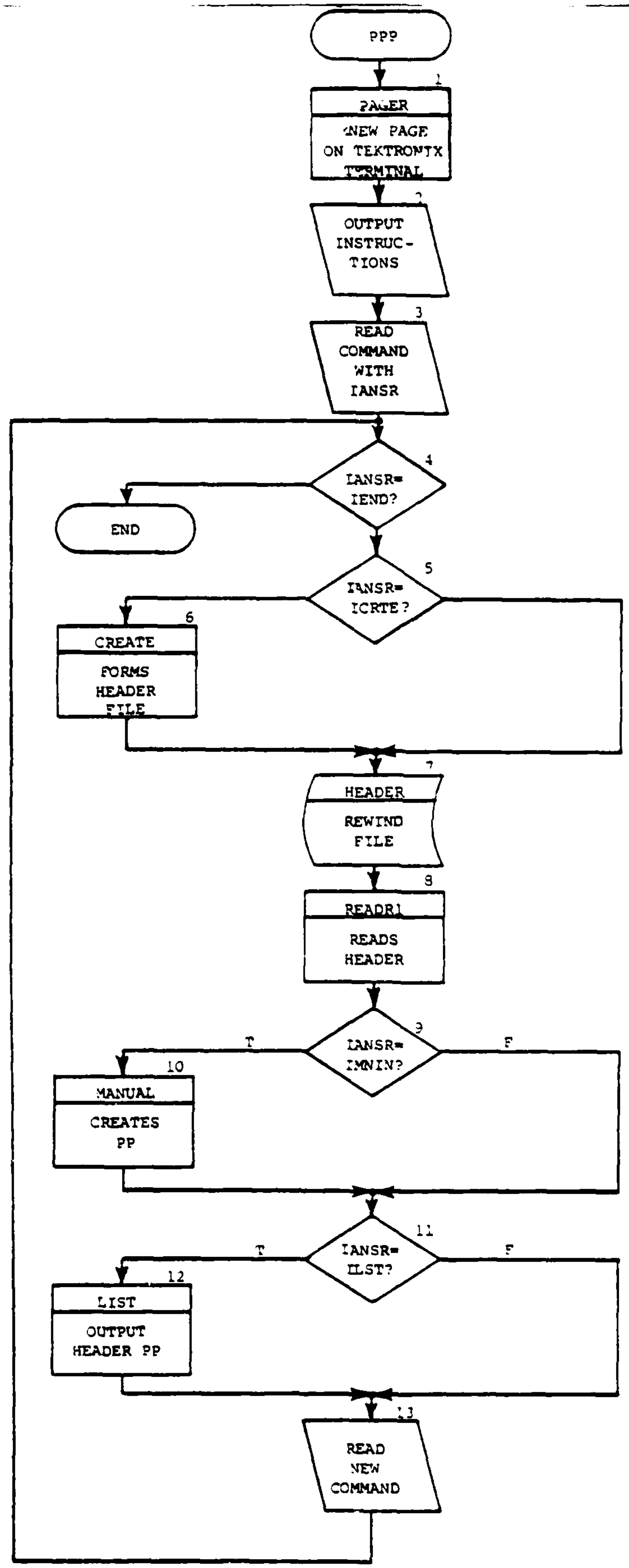

PPP
1
PAGER
NEW PAGE ON TEKTRONIX TERMINAL
2
OUTPUT INSTRUC-TIONS
3
READ COMMAND WITH IANSR
4
IANSR= IEND?
END
5
IANSR= ICRTE?
6
CREATE
FORMS HEADER FILE
7
HEADER
REWIND FILE
8
READR1
READS HEADER
9
IANSR= IMNIN?
T
F
10
MANUAL
CREATES PP
11
IANSR= ILST?
T
F
12
LIST
OUTPUT HEADER PP
13
READ NEW COMMAND

Chart No. 1.1
Module Name PAGER

(1.1) TEKTRONIX PAGER

This module contains TEKTRONIX subroutine calls that clears the screen and returns the cursor to home.

.1-.2 Subroutine INITT, BINITT initialized PLOT-10.

.3 Subroutine NEWPAG is PLOT-10 clearing function.

.4 Subroutine FINITT closes out PLOT-10.

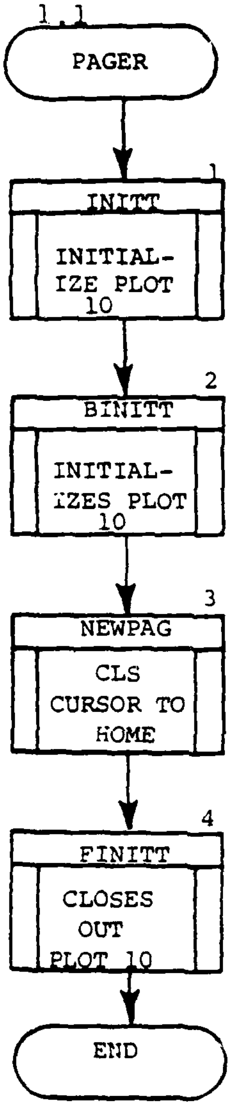

1.1
PAGER
1
INITT
INITIAL-
IZE PLOT
10
2
BINITT
INITIAL-
IZES PLOT
10
3
NEWPAG
CLS
CURSOR TO
HOME
4
FINITT
CLOSES
OUT
PLOT 10
END

Chart No. 1.6
Module Name CREATE

(1.6) CREATES the HEADER file

This module creates the HEADER file.

.1 Read in all system and parameter names, parameter types, number of levels.

.2 Rewind file.

.3 Write names, etc. to file.

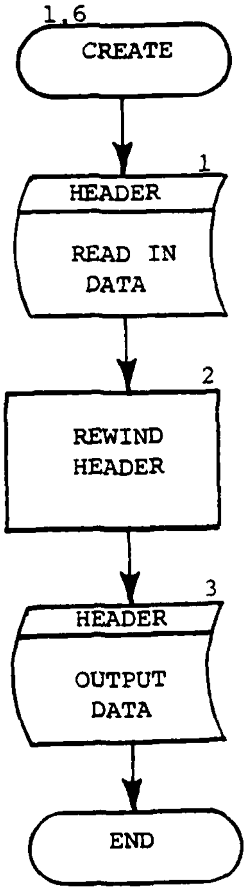

1.6
CREATE
1
HEADER
READ IN DATA
2
REWIND HEADER
3
HEADER
OUTPUT DATA
END

Chart No. 1.1.8
Module Name READR1

(1.8) READ in HEADER

This module reads in the data file HEADER.

.1 Rewind the file.

.2 Read in all names, numbers, parameter types.

.3-.4 If no level 1 subsystems, INDEX=1.

.5-.6 If no level 2 subsystems, INDEX=number of level 1 subsystems.

.7 Otherwise, INDEX=product of numbers of level 1 and 2 subsystems.

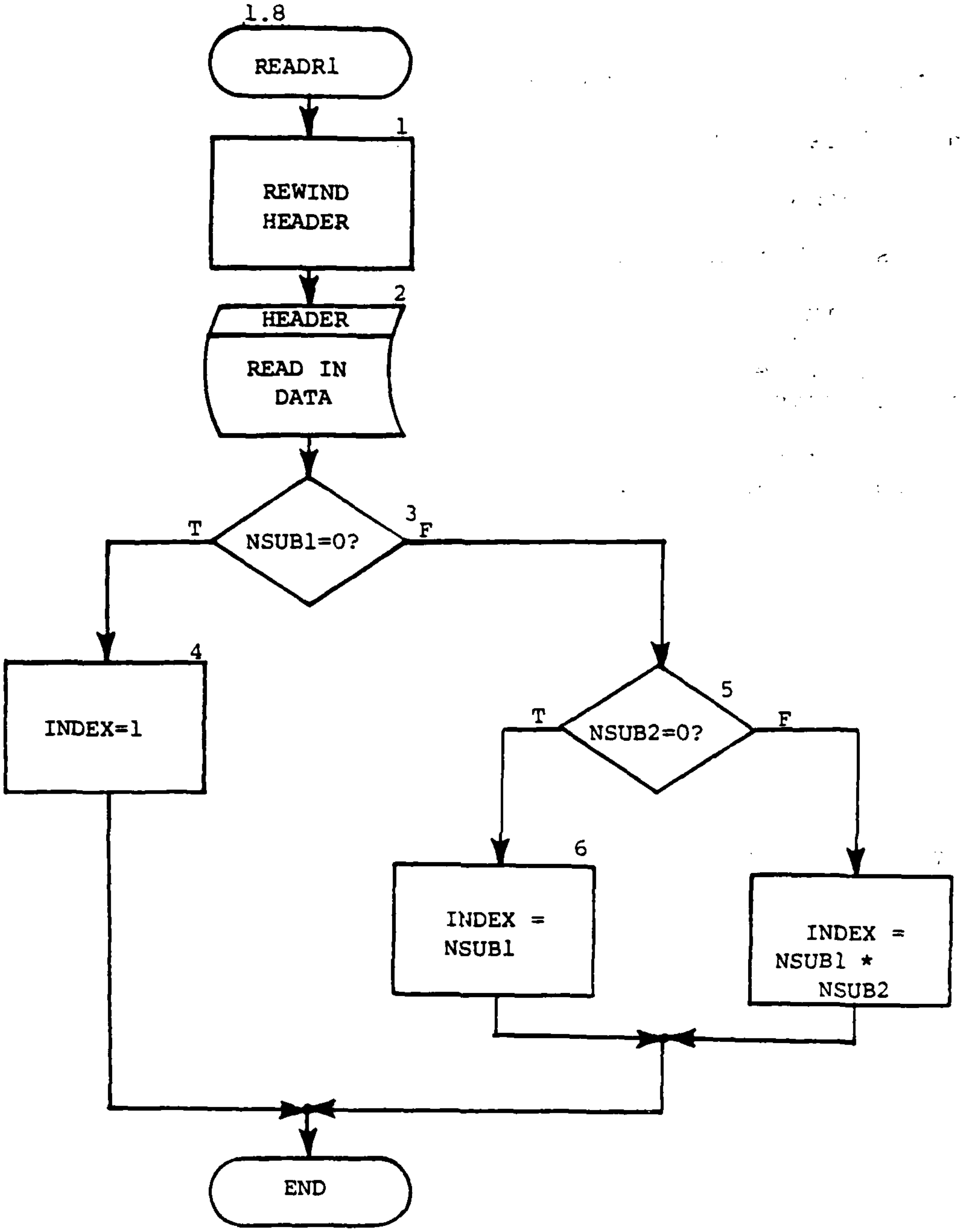

1.8
READR1
1
REWIND HEADER
2
HEADER
READ IN DATA
3
T
F
NSUB1=0?
4
INDEX=1
5
T
F
NSUB2=0?
6
INDEX = NSUB1
INDEX = NSUB1 * NSUB2
END

Chart No. 1.10
Module Name MANUAL

(1.10) MANUALy enter the PP

The module allows the user to enter in the parameter values.

.1 Rewind PP file.

.2 SYSDSN indicates the correct branching.

.3-.4 Parameters entered and written to file for systems only.

.5-.6 Parameters are entered and written to file for systems and subsystems.

.7-.8 Parameters are entered and written to file for systems and level 1 and 2 subsystems.

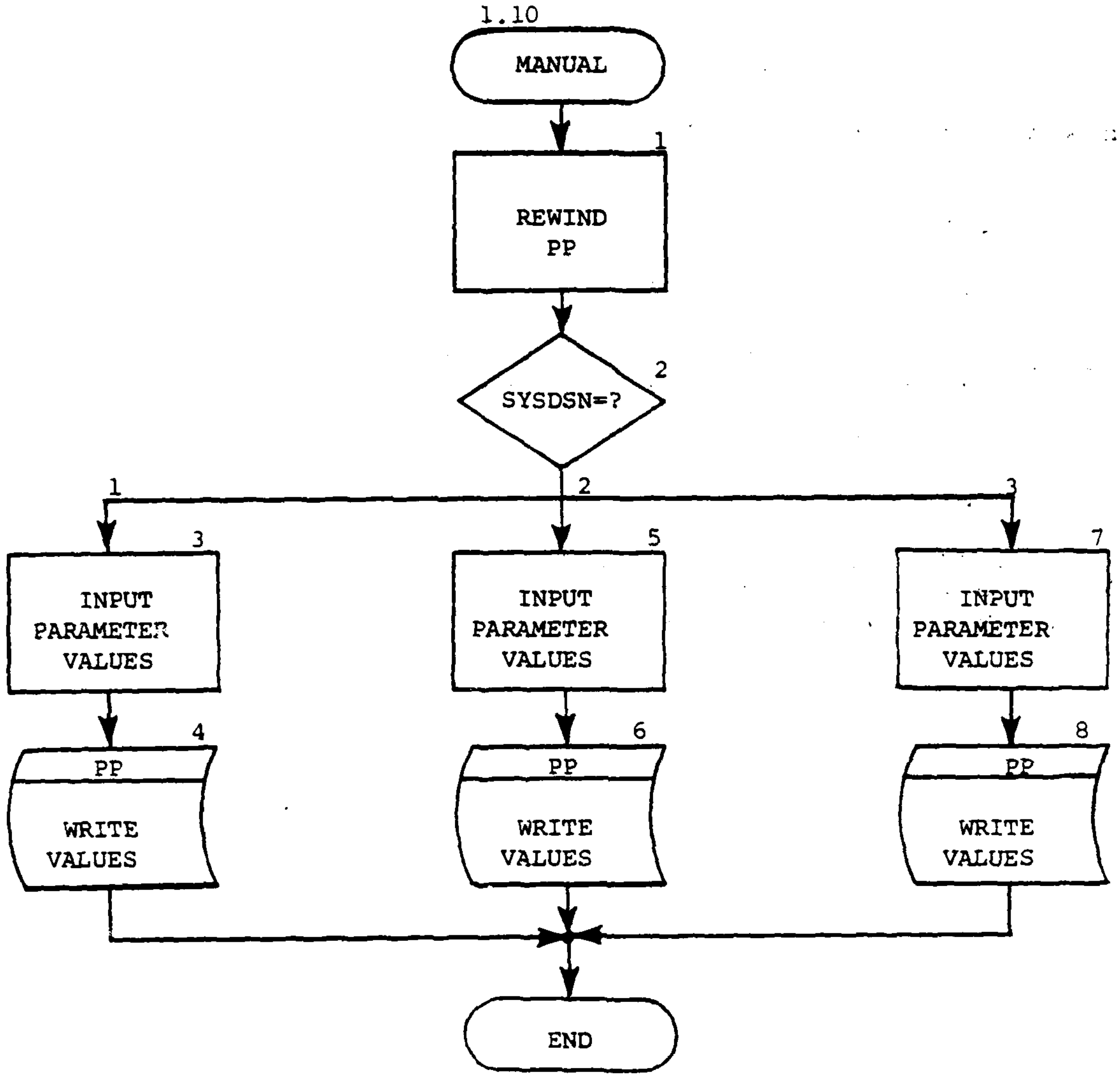

1.10
MANUAL
1
REWIND
PP
2
SYSDSN=?
1
2
3
3
INPUT
PARAMETER
VALUES
5
INPUT
PARAMETER
VALUES
7
INPUT
PARAMETER
VALUES
4
PP
WRITE
VALUES
6
PP
WRITE
VALUES
8
PP
WRITE
VALUES
END

Chart No.   1.12
Module Name LIST

(1.12) LIST the parameter names and values

This module prints a table containing the parameter names and values.

.1 Rewind PP.

.2 SYSDSN indicates the correct branching.

.3-.5 For systems, with PAGER and write out parameter names WRTOUT outputs system names and parameter values.

.6-.8 For systems and level 1 subsystems page with PAGER and write out parameter names. WRTOUT outputs system and subsystem names and parameter values.

.9-.11 For systems and level 1 and 2 subsystems, page with PAGER and write out parameter names. WRTOUT output systems and subsystem names and parameters values.

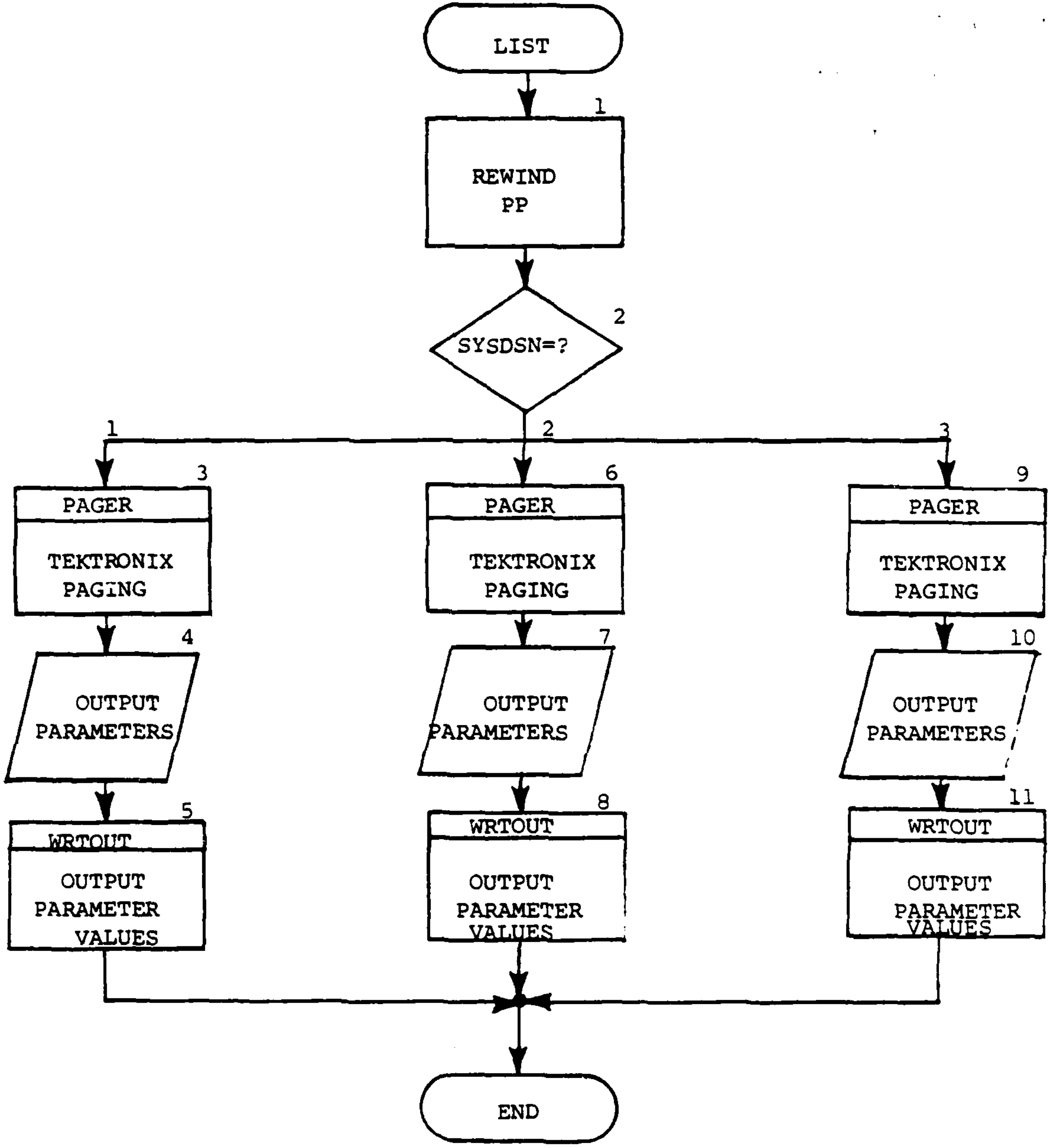

LIST
1
REWIND
PP
2
SYSDSN=?
1
2
3
3
PAGER
TEKTRONIX
PAGING
6
PAGER
TEKTRONIX
PAGING
9
PAGER
TEKTRONIX
PAGING
4
OUTPUT
PARAMETERS
7
OUTPUT
PARAMETERS
10
OUTPUT
PARAMETERS
5
WRTOUT
OUTPUT
PARAMETER
VALUES
8
WRTOUT
OUTPUT
PARAMETER
VALUES
11
WRTOUT
OUTPUT
PARAMETER
VALUES
END

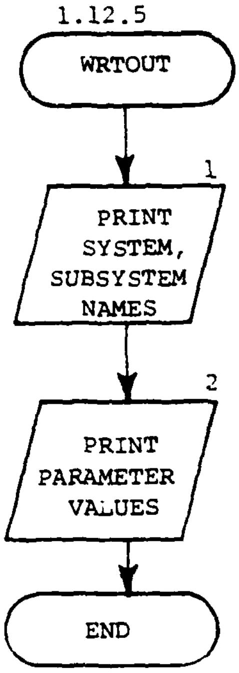
Chart No.   1.12.5
Mdoule Name WRTOUT

(1.12.5) WriTeOUT the parameter values

This module outputs the system and subsystems names and parameter values.

.1 Print names

.2 Print parameter values corresponding to names.


1.12.5
WRTOUT
1
PRINT SYSTEM, SUBSYSTEM NAMES
2
PRINT PARAMETER VALUES
END

APPENDIX F - GRAPHX AND GRAPHT FLOWCHART AND NARRATIVE

GRAPHX and GRAPHT, the two graphics programs for the system selection model, provide both histogram and data-point graphical output. GRAPHX creates graphs that plot system values versus systems in a vertical histogram format, and GRAPHT creates graphs of system values versus time, to demonstrate effects of time-variant parameters on the decision results. The time intervals must be input to the system as the lowest-level subsystem, and the problem must of course be Case 1 or 2 to accommodate this requirement. The "time graphs," as they are referred to, contain one curve per system on each graph. The following set of flowcharts and narratives describe the general structure of the programs; however, it is recommended that those who wish to really understand the programs refer to the Tektronix manuals referenced in the narratives.

Chart Number 1
Module Name GRAPHT

1.1 Program GRAPHT graphs system values against time at specified intervals, with a separate curve for each system. Time intervals must be specified in either level 1 or level 2 subsystems, and must be five in number.

1.2 Rewind HEADER, containing names and numbers, and SYSNUM, containing final system rating values.

1.3 Read in HEADER via program READR.

1.4 Read SYSNUM values into array SYSNRM.

1.5 Obtain frm user IBAUD and JTERM, baud rate and terminal type used by PLOT-10 initialization routines.

1.6 Problem must be Case 2 or Case 3, and must have exactly five lowest level subsystems. (Error message if conditions are not satisfied.)

1.7-1.9 Call appropriate overlay to make graph.

AD-A119 160 SOUTHEASTERN CENTER FOR ELECTRICAL ENGINEERING EDUCAT--ETC F/G 9/2
ADVANCED TECHNOLOGY MULTIPLE CRITERIA DECISION MODEL.(U)
NOV 81 P J SWEENEY, K B BERNER, J R FRAKER F33615-77-C-2059
UNCLASSIFIED AFWAL-TR-81-2112 NL

3 of 4
AD A
19 60

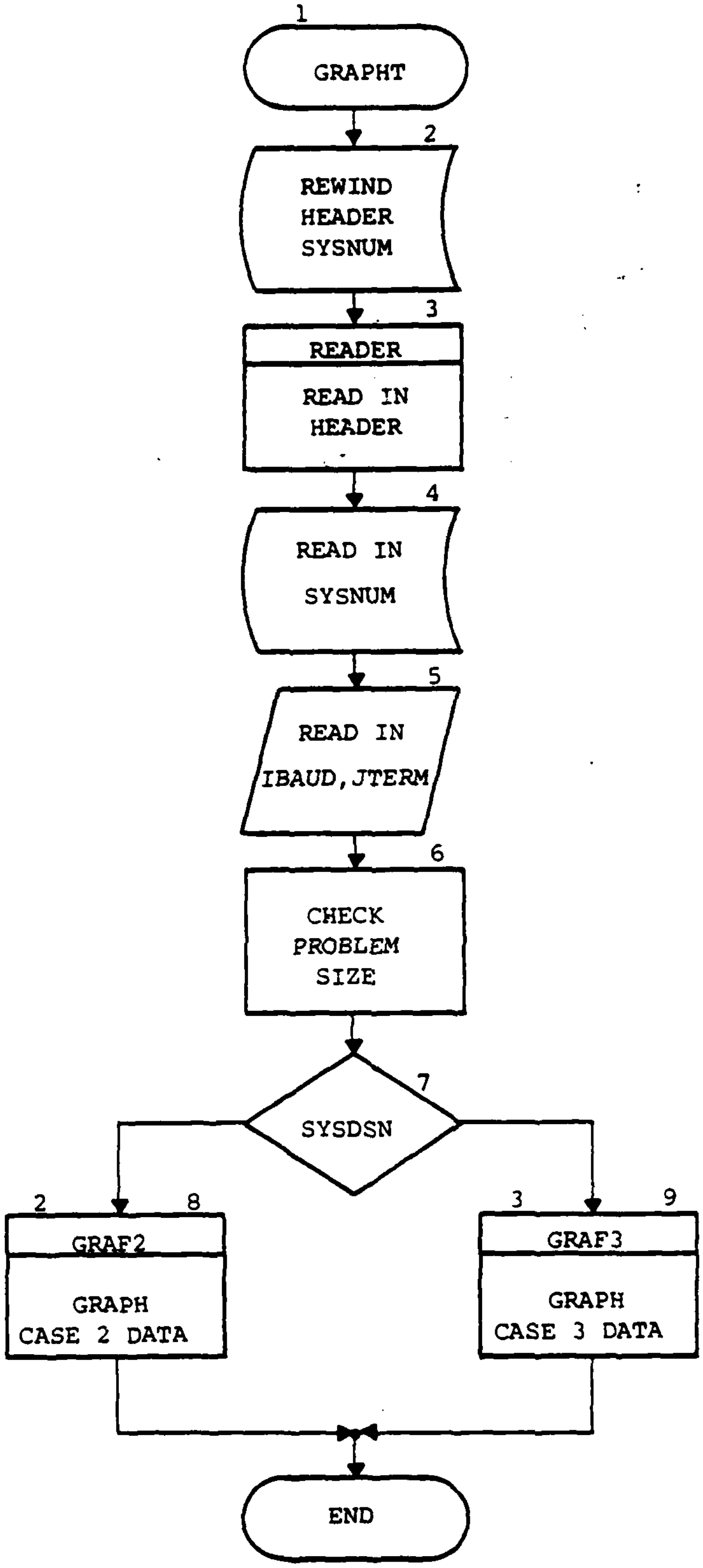

1
GRAPHT
2
REWIND
HEADER
SYSNUM
3
READER
READ IN
HEADER
4
READ IN
SYSNUM
5
READ IN
IBAUD,JTERM
6
CHECK
PROBLEM
SIZE
7
SYSDSN
2
8
GRAF2
GRAPH
CASE 2 DATA
3
9
GRAF3
GRAPH
CASE 3 DATA
END

Chart Number 1.3
Module Name GRAPHT

1.3.1 Program READR reads in HEADER data, figures INDEX.

1.3.2 Read in data.

1.3.3-1.3.7 INDEX calculated, based on problem type:

Case 1--INDEX = 1

Case 2--INDEX = NSUB1

Case 3--INDEX = NSUB1*NSUB2

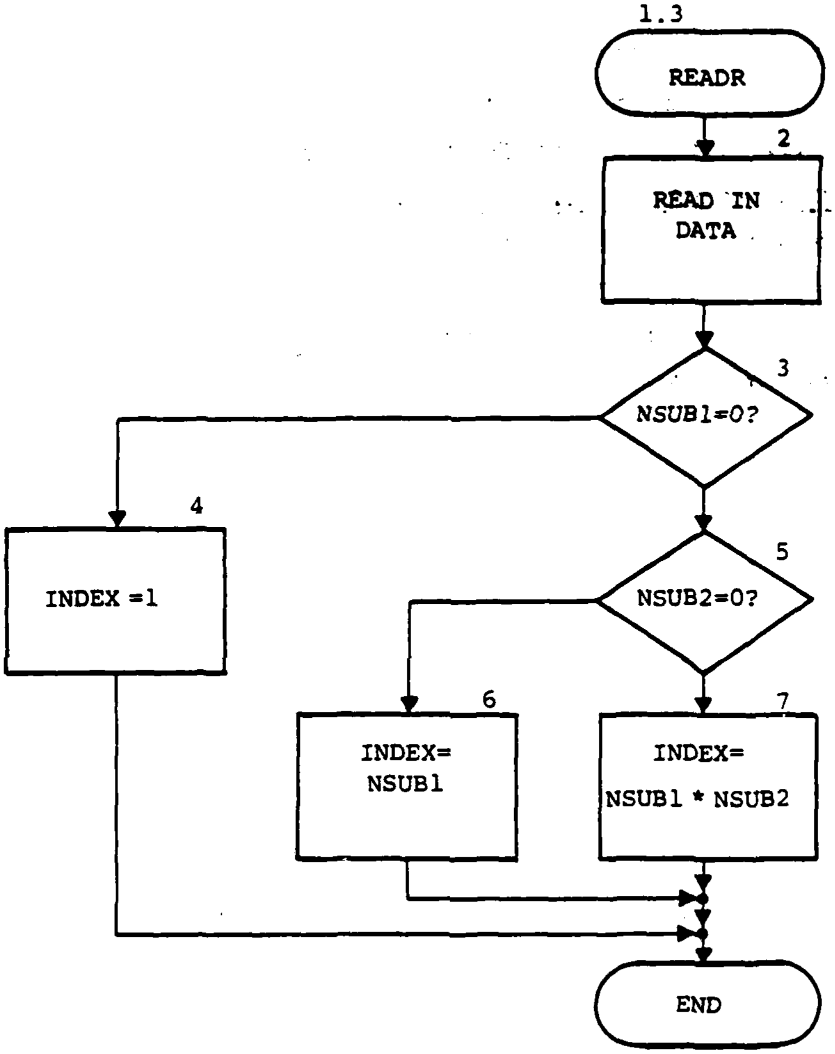

1.3
READR
2
READ IN DATA
3
NSUB1=0?
4
INDEX =1
5
NSUB2=0?
6
INDEX= NSUB1
7
INDEX= NSUB1 * NSUB2
END

Chart Number 1.8
Module Name GRAPHT

1.8.1 Program GRAF2 creates one graph of Case 2 data.

1.8.2-1.8.4 TEKTRONIX PLOT-10 software subroutines; for more information on these and their operation, see TEKTRONIX manuals for Terminal Control System (TCS) and Advanced Graphics (AG-II), part numbers 062-1474-00 and 062-1530-00, respectively.

1.8.5 TINPUT waits for any key followed by an ETX, then continues; used as delay for examination/hard-copying of graph.

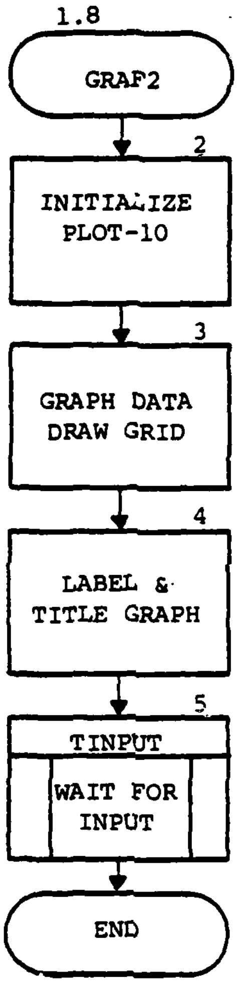

1.8
GRAF2
2
INITIALIZE
PLOT-10
3
GRAPH DATA
DRAW GRID
4
LABEL &
TITLE GRAPH
5
TINPUT
WAIT FOR
INPUT
END

Chart Number 1.9
Module Name GRAPHT

1.9.1 Program GRAF3 creates (NSUB1) graphs of the Case 3 data.

1.9.2-1.9.2.5 Subroutines to draw, label, adjust graph.

1.9.6 TINPUT delays, waiting for character and ETX input.

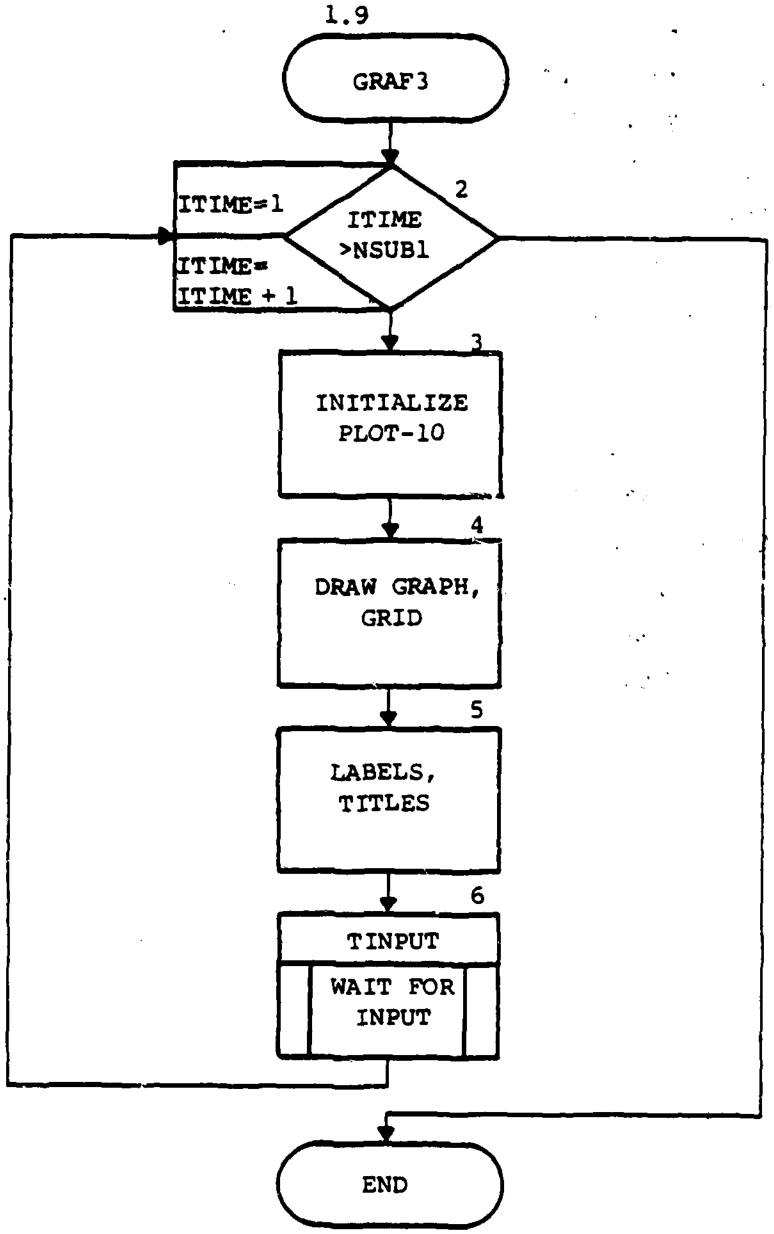

1.9
GRAF3
2
ITIME=1
ITIME >NSUB1
ITIME= ITIME + 1
3
INITIALIZE PLOT-10
4
DRAW GRAPH, GRID
5
LABELS, TITLES
6
TINPUT
WAIT FOR INPUT
END

Chart Number 1
Module Name GRAPHX

1.1 Program GRAPHX does a bar graph output of the results from SSMP.

1.2 Rewind data files. HEADER contains size and names for problem, SYSNUM contains system rating values (from SSMP).

1.3 Read initialization parameters (baud rate and terminal type) from user. This is necessary for TEXTRONIX PLOT-10 software routines.

1.4 Read in HEADER via program READR.

1.5 Read in SYSNUM data into SYSNRM array.

1.6 Assign x-values in linear expansion form (see PLOT-10 manuals).

1.7-1.10 Go to appropriate program, according to value of SYSDSN.

1.11 Stop execution.

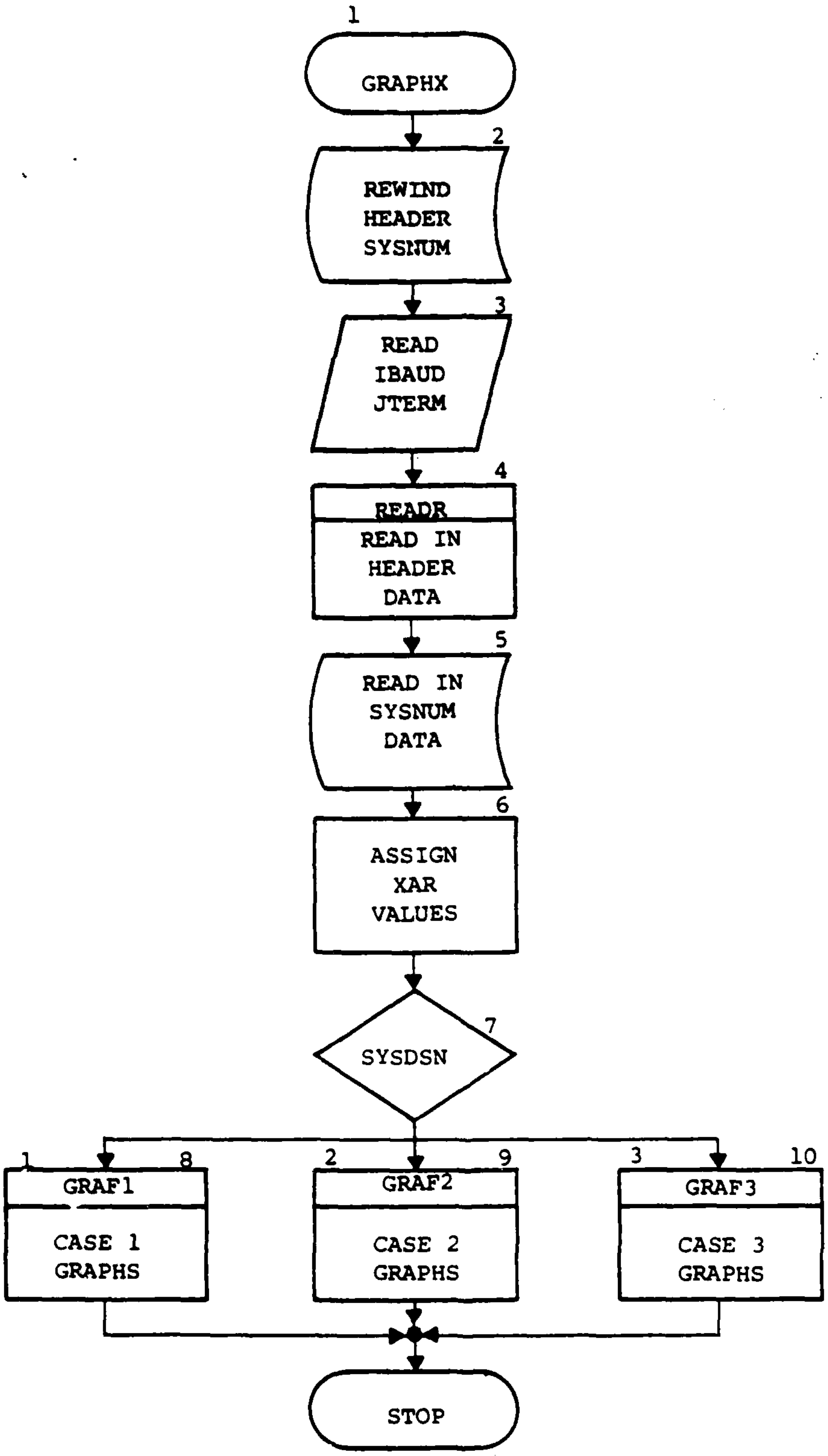

1
GRAPHX
2
REWIND
HEADER
SYSNUM
3
READ
IBAUD
JTERM
4
READR
READ IN
HEADER
DATA
5
READ IN
SYSNUM
DATA
6
ASSIGN
XAR
VALUES
7
SYSDSN
1
8
GRAF1
CASE 1
GRAPHS
2
9
GRAF2
CASE 2
GRAPHS
3
10
GRAF3
CASE 3
GRAPHS
STOP

Chart Number 1.4
Module Name GRAPHX

1.4.1 Program READR reads in HEADER data.

1.4.2 Read in values from file HEADER.

1.4.3-1.4.7 Assign value to INDEX according to size of problem as follows:

Case 1--INDEX = 1

Case 2--INDEX = NSUB1

Case 3--INDEX = NSUB1*NSUB2

1.4.8 Terminate.

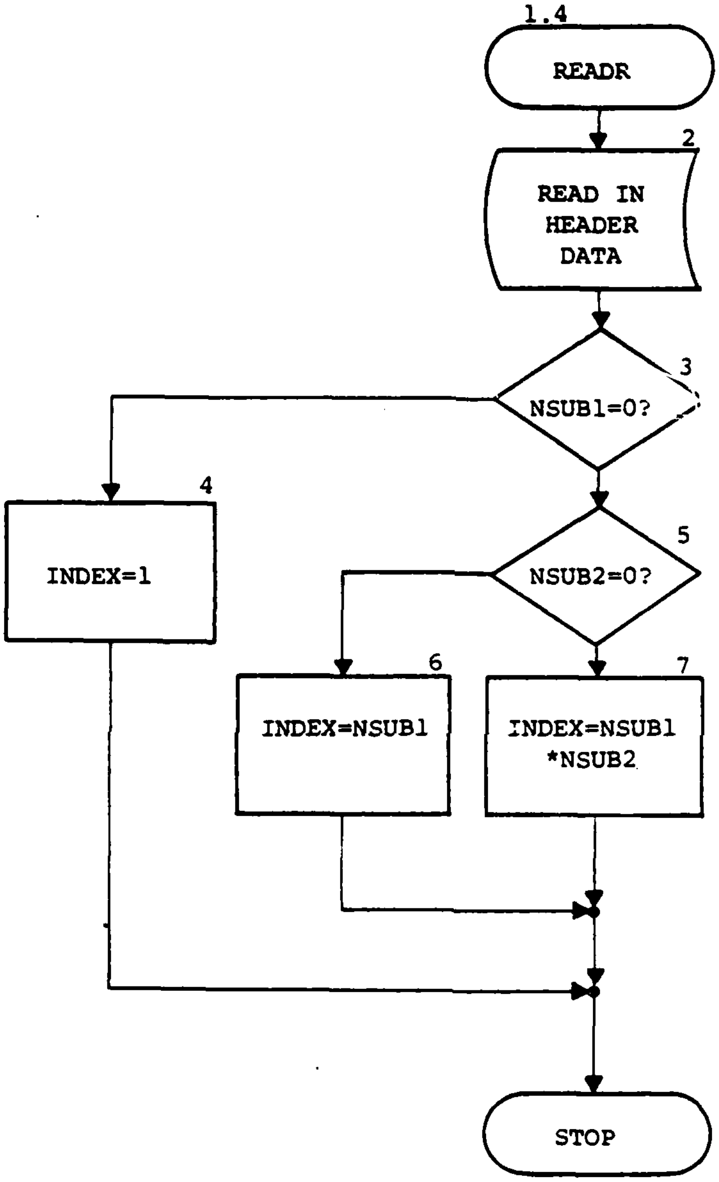

1.4
READR
2
READ IN HEADER DATA
3
NSUB1=0?
4
INDEX=1
5
NSUB2=0?
6
INDEX=NSUB1
7
INDEX=NSUB1 *NSUB2
STOP

Chart Number 1.8
Module Name GRAPHX

1.8.1 Program GRAF1 graphs Case 1 data; creates one graph.

1.8.2-1.8.4 Assign y-values for graph from SYSNUM data (in array SYSNRM).

1.8.5 Initialize PLOT-10 software system.

1.8.6-1.8.7 All routines for drawing, labeling, and titling graphs, as well as certain parameters to set special features of graphs. For more information, see TEKTRONIX manuals for Terminal Control System (TCS) and Advanced Graphics (AG-II), part numbers 062-1474-00 and 062-1530-00, respectively.

1.8.8 TINPUT waits for user input; any keystroke and ENTER will cause the program to continue.

1.8.9-1.8.10 Exit PLOT-10 and terminate.

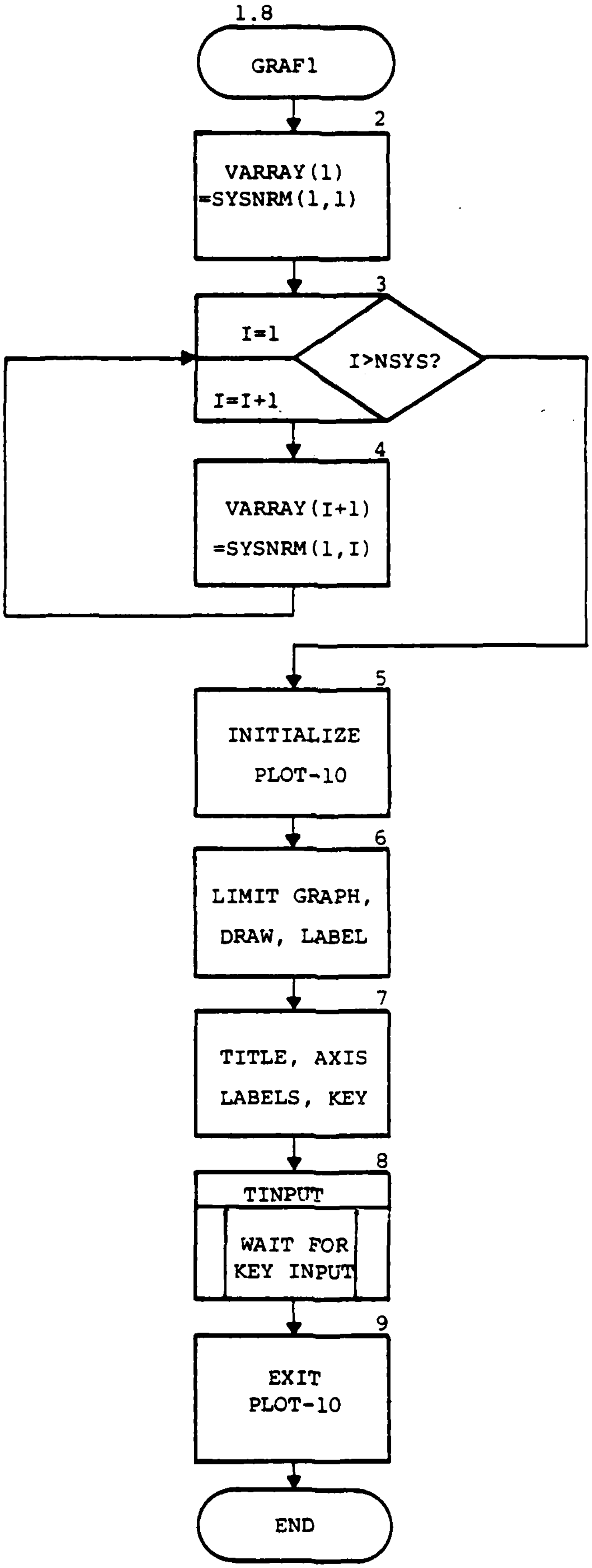

1.8
GRAF1
2
VARRAY(1)
=SYSNRM(1,1)
3
I=1
I>NSYS?
I=I+1
4
VARRAY(I+1)
=SYSNRM(1,I)
5
INITIALIZE
PLOT-10
6
LIMIT GRAPH,
DRAW, LABEL
7
TITLE, AXIS
LABELS, KEY
8
TINPUT
WAIT FOR
KEY INPUT
9
EXIT
PLOT-10
END

Chart Number 1.9
Module Name GRAPHX

1.9.1 Program GRAF2 graphs Case 2 data and creates NSUB1 graphs.

1.9.2 Do-loop to create graphs, number = number of level 1 subsystems.

1.9.3-1.9.7 Assign y-values, initialize system, graph, wait for input to do next graphs.

1.9.8-1.9.9 Exit PLOT-10 and terminate.

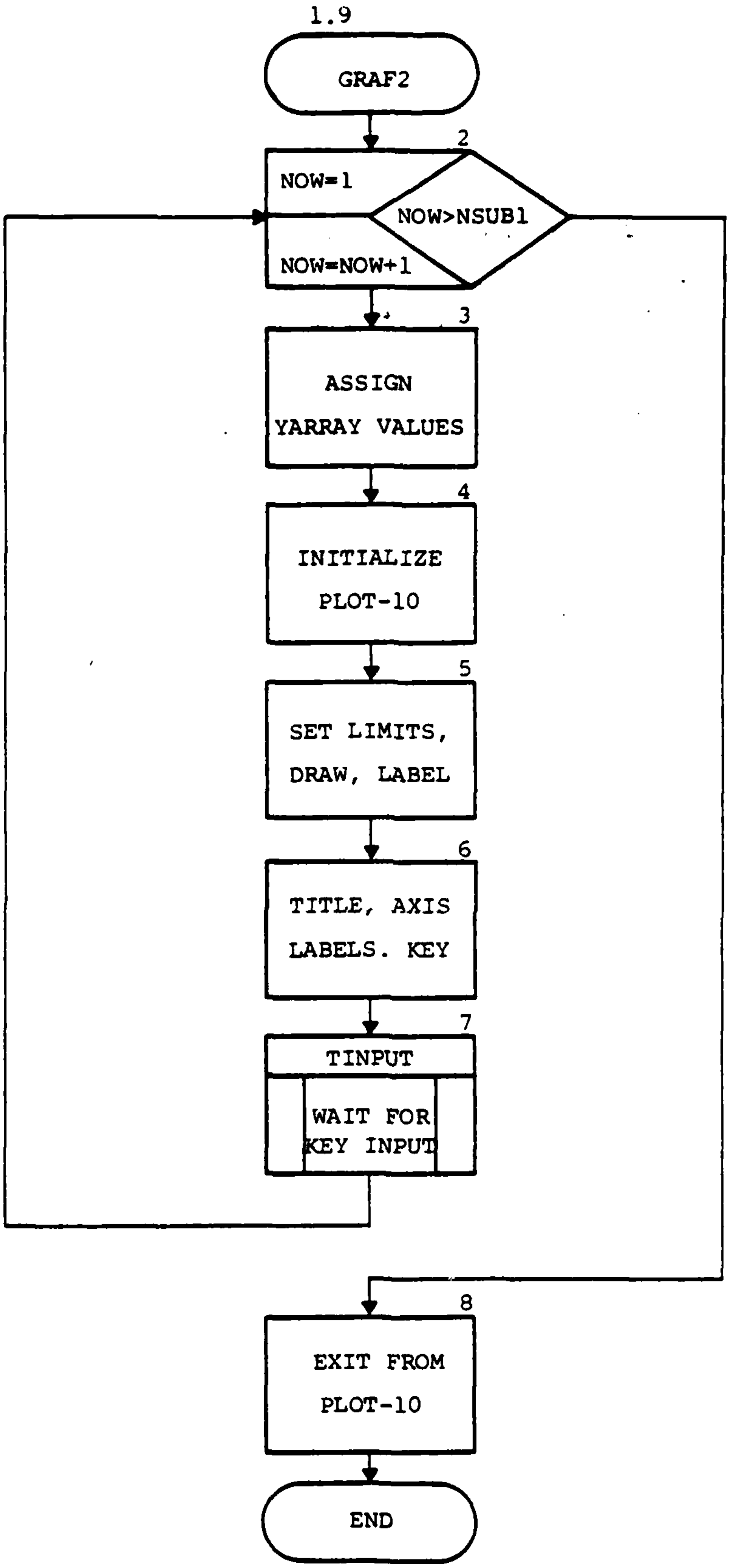

1.9
GRAF2
2
NOW=1
NOW>NSUB1
NOW=NOW+1
3
ASSIGN
YARRAY VALUES
4
INITIALIZE
PLOT-10
5
SET LIMITS,
DRAW, LABEL
6
TITLE, AXIS
LABELS. KEY
7
TINPUT
WAIT FOR
KEY INPUT
8
EXIT FROM
PLOT-10
END

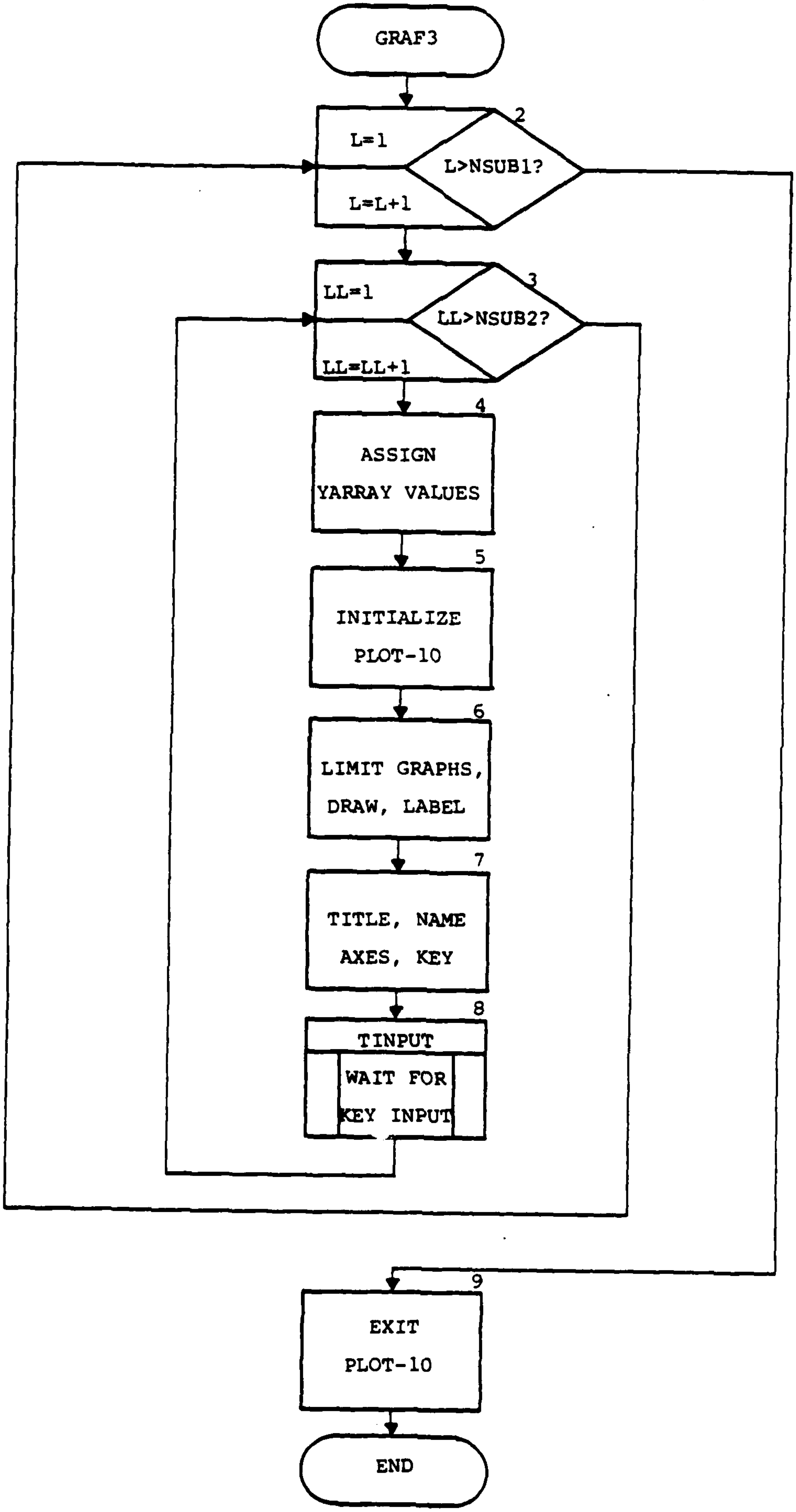
Chart Number 1.10
Module Name GRAPHX

1.10.1 Program GRAF3. This graphs Case 3 data, creates NSUB1*NSUB2 graphs.

1.10.2-1.10.8 Do graphs, wait for input to clear and do another.

1.10.9-1.10.10 Exit PLOT-10 and terminate.

1.10


GRAF3
2
L=1
L>NSUB1?
L=L+1
3
LL=1
LL>NSUB2?
LL=LL+1
4
ASSIGN YARRAY VALUES
5
INITIALIZE PLOT-10
6
LIMIT GRAPHS, DRAW, LABEL
7
TITLE, NAME AXES, KEY
8
TINPUT
WAIT FOR KEY INPUT
9
EXIT PLOT-10
END

APPENDIX G - SSMP FLOWCHART AND NARRATIVE

SSMP, the System Selection Model Program, is the final step in executing the decision model. SSMP takes the three data files created by PPP and UPPP and integrates them into the problem, asks the user how the decision should be limited and output, and then performs the calculations and manipulations to eliminate and rate each system. This appendix contains a general flowchart and explanatory narrative of SSMP.

Chart No. 1
Module Name SSM

(1) System Selection Model

.1 Reads in Parameter Package (PP) and calls RUPP that Reads in User's Preference Packag (UPP).

.2 Allows the user to select a scenario to enter parameter ratings.

.3 Prints out the parameter ratings.

.4 Allows the user to select the parameters to be in the decision process.

.5 Eliminates parameter data as specified by parameter limits and calls TABLE to print out eliminated system and/or sub-system.

.6 If the numerical parameters chosen need inverting then this model performs the necessary calculations.

.7 Calculates the utility values for each system and calls OUTPUT to print out the results.

.8 Allows the user to execute the program again. This option can be used to an analysis of the uncertainity of the decision model.

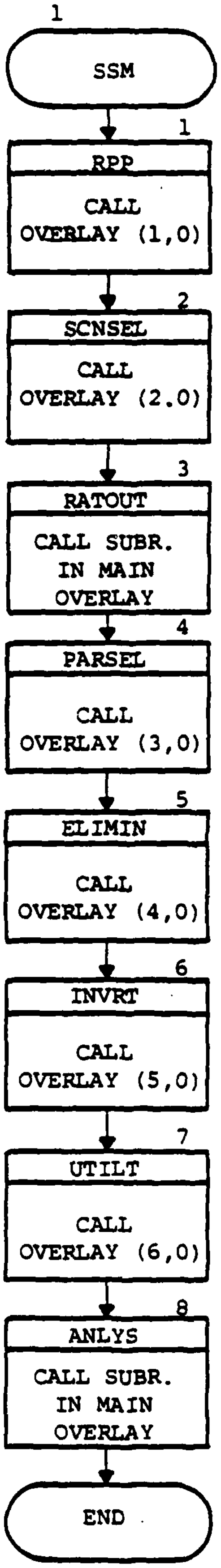

1
SSM
1
RPP
CALL
OVERLAY (1,0)
2
SCNSEL
CALL
OVERLAY (2.0)
3
RATOUT
CALL SUBR.
IN MAIN
OVERLAY
4
PARSEL
CALL
OVERLAY (3,0)
5
ELIMIN
CALL
OVERLAY (4,0)
6
INVRT
CALL
OVERLAY (5,0)
7
UTILT
CALL
OVERLAY (6,0)
8
ANLYS
CALL SUBR.
IN MAIN
OVERLAY
END

Chart No. 1.1
Module Name RPP

(1.1) Read in Parameter Package

This procedure reads in the Parameter Package (PP) from the data file HEADER and stores the information in labeled COMMON statements.

.1 Read DBNAME, the problem name for the data bases.

.2 Read SYSDSN; 1=Case 1 (no subsystems); 2=Case 2 (level 1 subsystems); 3=Case 3 (level 1 and 2 subsystems).

.3 Read in NSYS, NSUB2 and NPARM.

.4 Read in the setnames for the systems and, if any, subsystems.

.5 Read in the specific names for the systems and, if any, level 1 and 2 subsystems.

.6 Read in parameter names and the values indicating the type of parameter and if it is to be inverted. The value of 1 means YES, and 0 means NO.

.7 INDEX is calculated to help facilitate the indexing of arrays. Since there is a maximum of 3 dimensional arrays, a fourth dimension is combined with another dimension for Case 3.

.8 The RUPP module reads in the UPP data file.

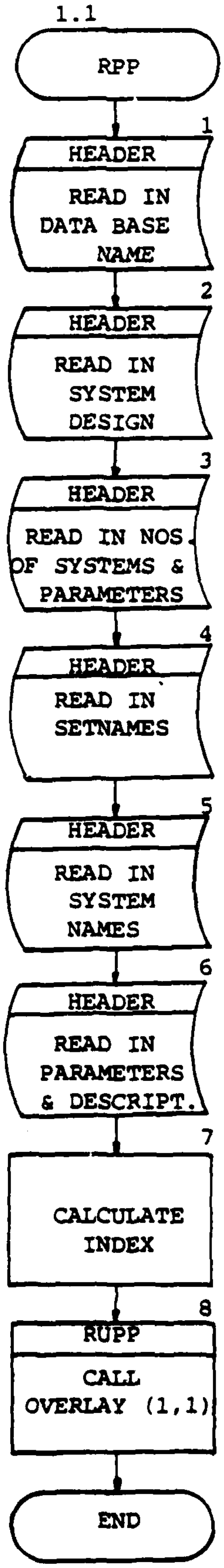

1.1
RPP
1
HEADER
READ IN DATA BASE NAME
2
HEADER
READ IN SYSTEM DESIGN
3
HEADER
READ IN NOS. OF SYSTEMS & PARAMETERS
4
HEADER
READ IN SETNAMES
5
HEADER
READ IN SYSTEM NAMES
6
HEADER
READ IN PARAMETERS & DESCRIPT.
7
CALCULATE INDEX
8
RUPP
CALL OVERLAY (1,1)
END

Chart No. 1.1.8
Module Name RUPP

(1.1.8) Read in User's Preference Package

This module reads in the data file called user's preference package from the file called UPP and stores the information in labeled COMMON statements.

.1 Read in the number of scenarios available, NSCEN.

.2-.3 Check to see if NSCEN is greater than zero, if not, print an error message.

.4-.5 Read in the scenario description, SCNDSC, with an alphanumeric format of 15A4 giving a limit of 60 characters.

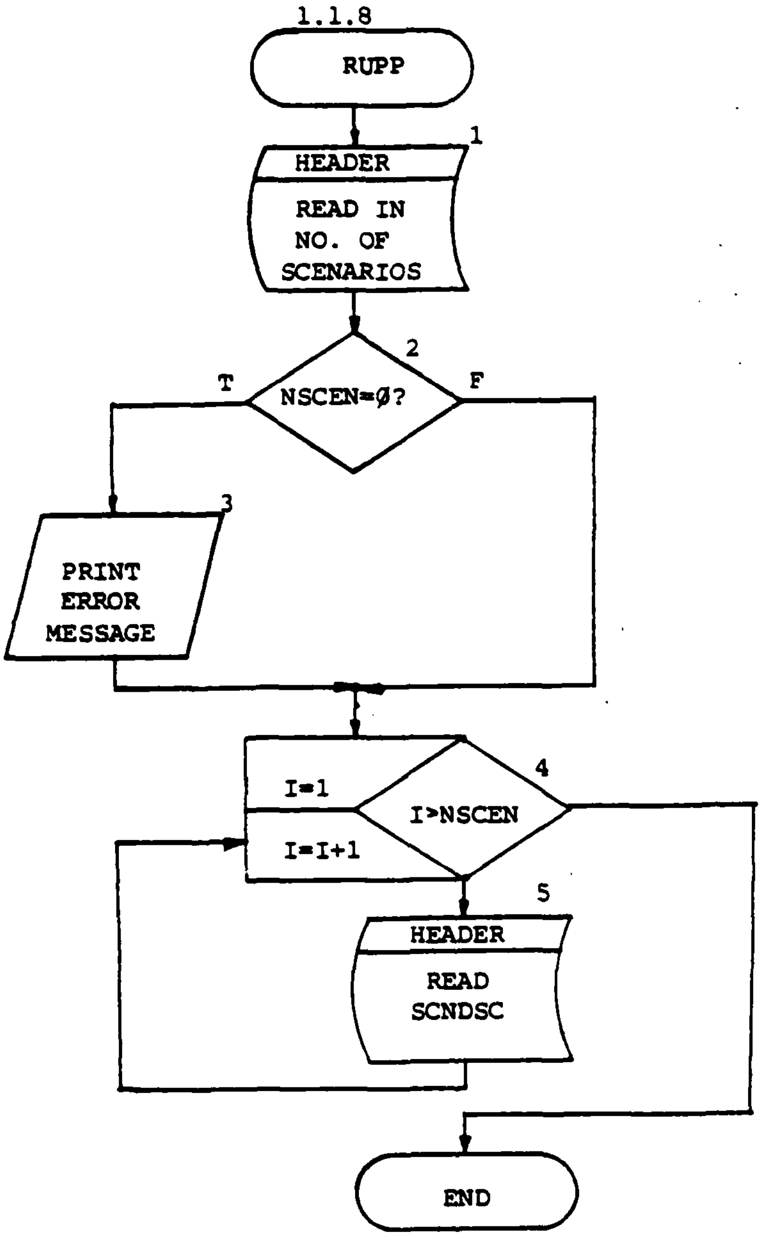

1.1.8
RUPP
1
HEADER
READ IN
NO. OF
SCENARIOS
2
T
NSCEN=Ø?
F
3
PRINT
ERROR
MESSAGE
4
I=1
I>NSCEN
I=I+1
5
HEADER
READ
SCNDSC
END

Chart No. 1.2
Module Name SCNSEL

(1.2) SCeNario SELection

.1-.2 Print out the available parameters.

.3 The user chooses between entering his or her own ratings or the ratings available under the different scenarios.

.4 Set the variable that indicates the choice of scenario to 1.

.5 Read in the scenario description, SCNDSC, maximum 60 characters.

.6 Print out each parameter and then read in a corresponding parameter rating.

.7 Check each parameter rating to see if exceed its ranges.

.8 If the rating is not a correct value an error message is printed.

.9 The ratings are stored in another array for future use.

.10 If the user decides to use an available scenario, the program prints out the descriptions of available scenarios.

.11 The user indicates his or her choice of a scenario by an integer variable ICHOIC.

.12 Check to see if ICHOIC does not exceed any ranges.

.13 If ICHOIC is incorrect the program prints an error message.

.14 Calculate INDEX1 to help facilitate file indexing.

.15 After positioning the UPP data file to the correct scenario then read in that scenario's ratings.

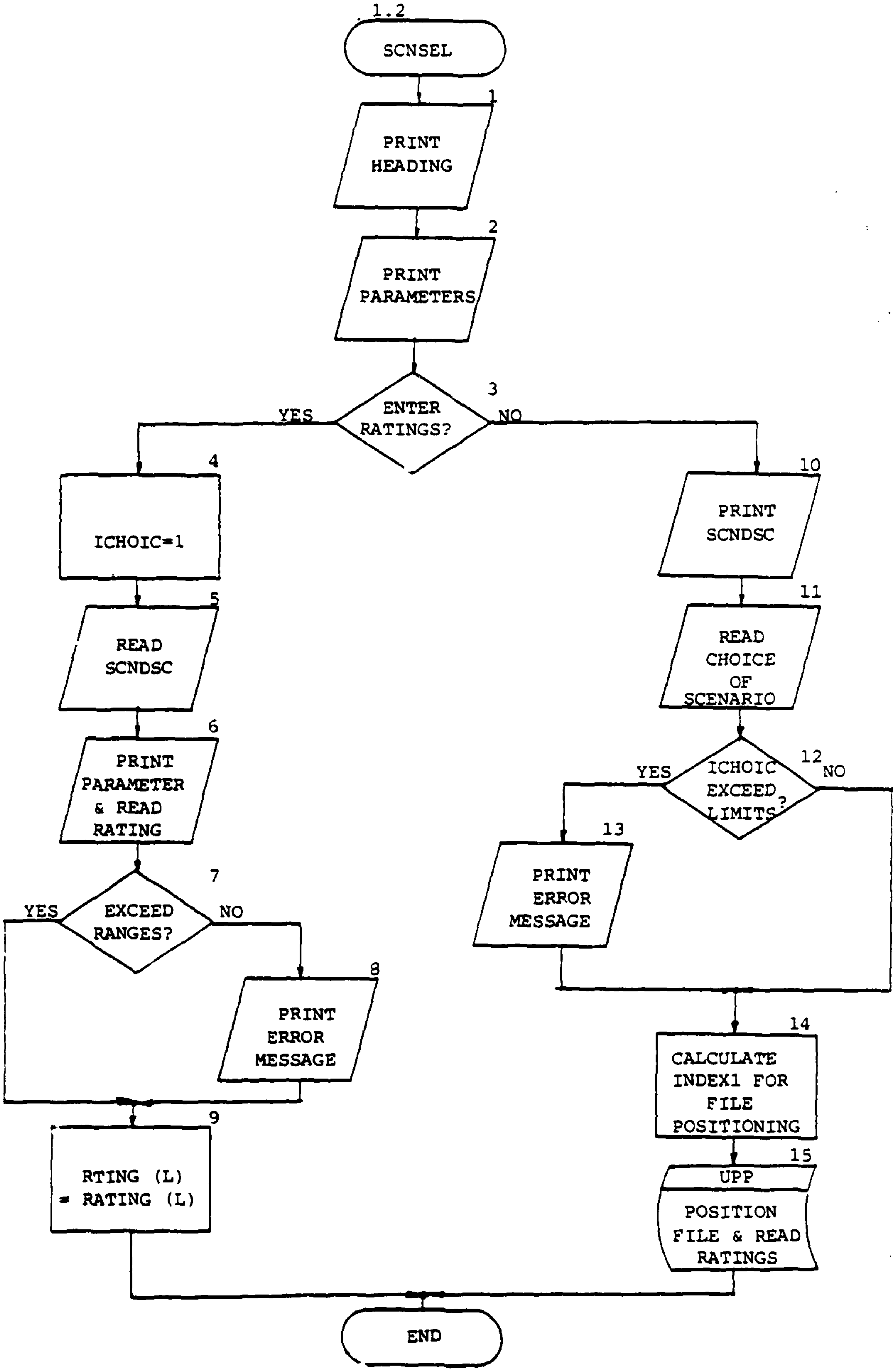

1.2
SCNSEL
1
PRINT HEADING
2
PRINT PARAMETERS
3
ENTER RATINGS?
YES
NO
4
ICHOIC=1
5
READ SCNDSC
6
PRINT PARAMETER & READ RATING
7
EXCEED RANGES?
YES
NO
8
PRINT ERROR MESSAGE
9
RTING (L) = RATING (L)
10
PRINT SCNDSC
11
READ CHOICE OF SCENARIO
12
ICHOIC EXCEED LIMITS?
YES
NO
13
PRINT ERROR MESSAGE
14
CALCULATE INDEX1 FOR FILE POSITIONING
15
UPP
POSITION FILE & READ RATINGS
END

Chart No. 1.3
Module Name RATOUT

(1.3) RATings OUTput

This module prints out the parameters ratings that either been entered by the user or from the scenario that has been chosen.

.1 Print the 60 character scenario description, SCNDSC.

.2-.3 Print the parameter name and rating.

.4 Finish printing the box.

.5 The module returns to the main overlay.

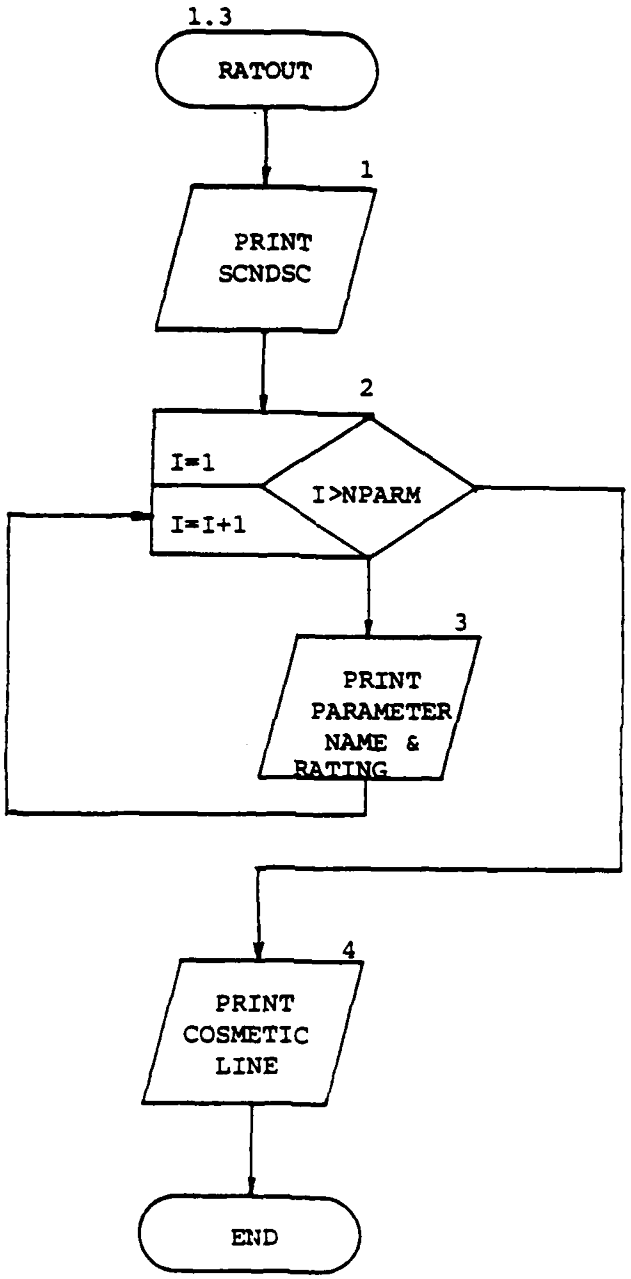

1.3
RATOUT
1
PRINT SCNDSC
2
I=1
I>NPARM
I=I+1
3
PRINT PARAMETER NAME & RATING
4
PRINT COSMETIC LINE
END

Chart No. 1.4
Module Name PARSEL

(1.4) PARameter SELection

This module allows the user to select the parameters and limits that will be used to participate in the decision process.

.1 Initialize several variables.

.2 Read the user's number of parameters wanted in the decision process.

.3 Then read in the choice of parameters, CHPRM.

.4-.5 Query the user to find out if any parameter limits are to be applied.

.6 Check to see of the parameter is numerical.

.7 Check to see if parameter is limited from above, below or both.

.8 Read, IRNG, if:

.9 1, then the program reads the lower limits, RLOWR.

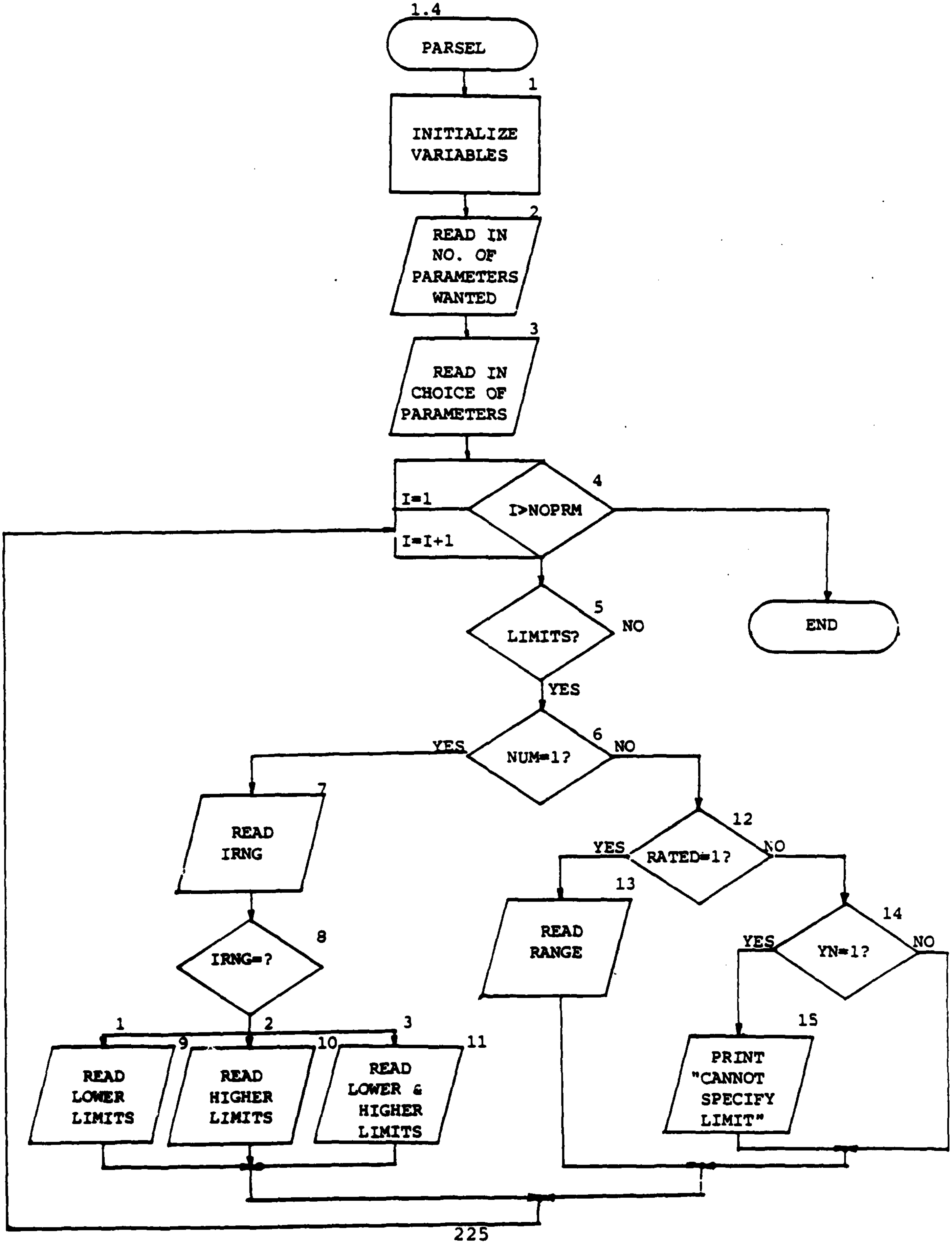
.10 2, then the program reads the higher limit, HIR.

.11 3, then the program reads both the higher and lower limits.

.12 If the parameter is not numerical then check and see if it is rated.

.13 Read the integer number (1-5) that will limit to the rated parameter to either, excellent, good, fair, poor, or very poor.

.14-.15 If the parameter is not either numerical or rated it is then considered a qualatative and a message prints out.


1.4
PARSEL
1
INITIALIZE VARIABLES
2
READ IN NO. OF PARAMETERS WANTED
3
READ IN CHOICE OF PARAMETERS
4
I=1
I>NOPRM
I=I+1
NO
END
5
LIMITS?
NO
YES
6
NUM=1?
YES
NO
7
READ IRNG
8
IRNG=?
1
2
3
9
READ LOWER LIMITS
10
READ HIGHER LIMITS
11
READ LOWER & HIGHER LIMITS
12
RATED=1?
YES
NO
13
READ RANGE
14
YN=1?
YES
NO
15
PRINT "CANNOT SPECIFY LIMIT"

(1.5) ELIMINation of Systems/Subsystems

This module eliminates systems/subsystems based on parameter limits. For more information see Appendix 7.3.

.1 Initialize the ELIM array to zero and the MATRIX array to one.

.2 Set up do-loop for all parameters.

.3 Set up do-loop for chosen parameters.

.4 Check to see if current parameter is a chosen parameter.

.5 If a chosen parameter then read in parameter data from PP data file.

.6-.7 Check to see if a numerical parameter and check range.

.8 If 1, then perform elimination process for parameter limited from above.

.9 If 2, then perform elimination process for parameter limited from below.

.10 If 3, then perform elimination process for parameter limited from above and below.

.11 If not a numerical parameter then check to see if a rated parameter.

.12 If a rated parameter then perform elimination process.

.13 Check to see if a qualitative parameter.

.14 Then the elimination process is performed.

.15 After the elimination process is finished then the data file is indexed to next parameter.

.16 If systems/subsystems have been eliminated then all of the parameter data for these systems or subsystems must also be eliminated.

.17 After all of the parameters have been checked then test to see if any system or subsystems have been eliminated. If nothing has been eliminated then the program module ends.

.18 If a system/subsystem has been eliminated then check to see if all systems and subsystems have been eliminated.

.19 If yes, then print message indicated that the parameter limits were such that no system/subsystem qualified.

.20 Write page title for output.

.21 Call program module TABLE that prints the elimination table.

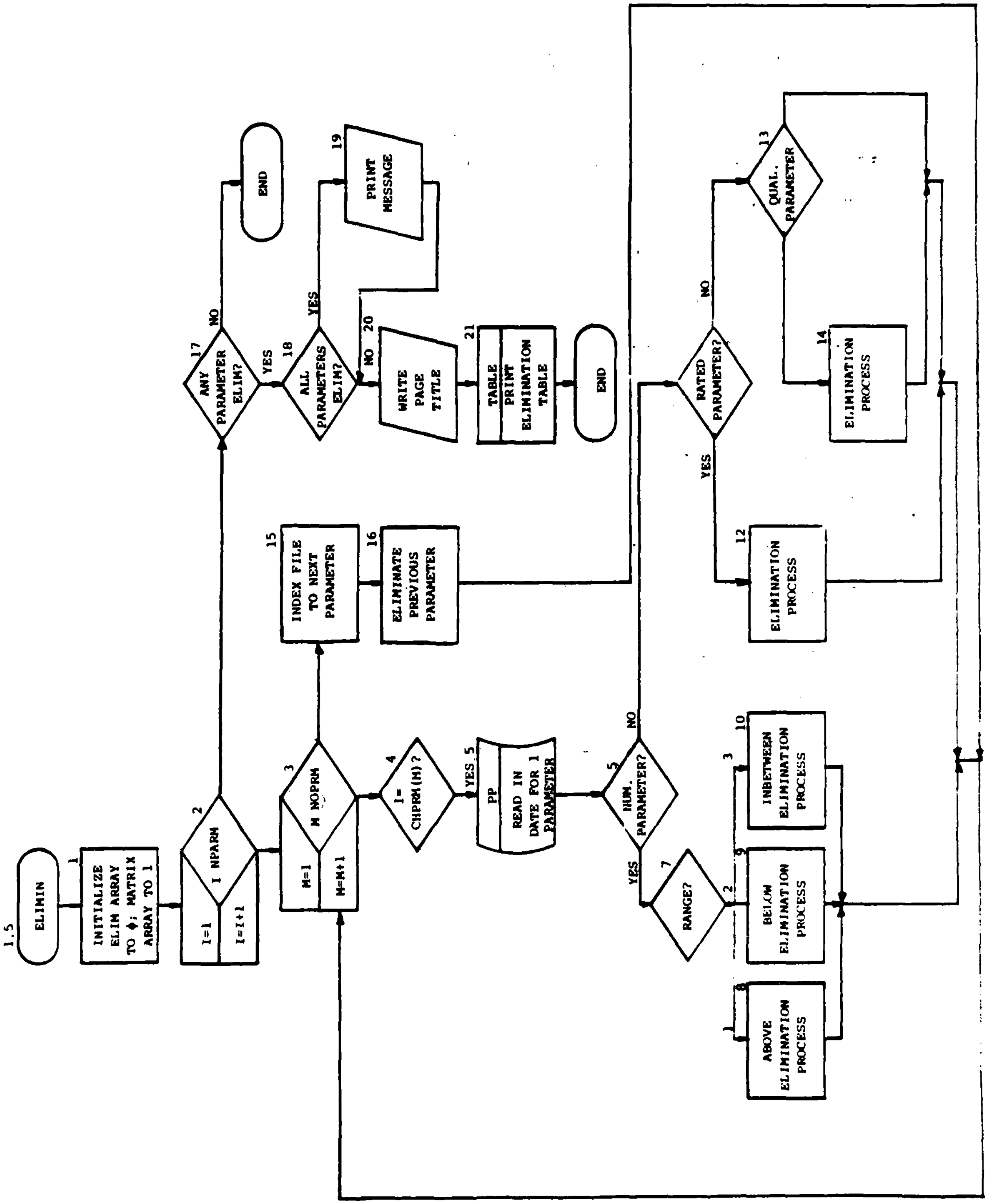

1.5
ELIMIN
1
INITIALIZE ELIM ARRAY TO ɸ; MATRIX ARRAY TO 1
2
I=1
I NPARM
I=I+1
3
M=1
M NOPRM
M=M+1
4
I= CHPRM(M)?
YES
5
PP
READ IN DATE FOR 1 PARAMETER
5
NUM. PARAMETER?
YES
7
RANGE?
1
8
ABOVE ELIMINATION PROCESS
2
9
BELOW ELIMINATION PROCESS
3
10
INBETWEEN ELIMINATION PROCESS
NO
RATED PARAMETER?
YES
12
ELIMINATION PROCESS
NO
13
QUAL. PARAMETER
14
ELIMINATION PROCESS
15
INDEX FILE TO NEXT PARAMETER
16
ELIMINATE PREVIOUS PARAMETER
17
ANY PARAMETER ELIM?
NO
END
YES
18
ALL PARAMETERS ELIM?
YES
19
PRINT MESSAGE
NO
20
WRITE PAGE TITLE
21
TABLE PRINT ELIMINATION TABLE
END

Chart No. 1.5.21
Module Name TABLE

(1.5.21) Elimination TABLE

This module prints out a table containing the reasons why a system or a subsystem was eliminated from the decision model.

.1 Print title.

.2 Check to see if Case 1, 2, or 3.

.3 Print heading for Case 1.

.4 Find out which parameters are eliminated.

.5 After a certain number of lines are printed out the output is started on a new page.

.6 Print out reason for elimination.

.7 Print heading for Case 2.

.8 Find out which parameters are eliminated.

.9 After a certain number of lines are printed out the output is started on a new page.

.10 Print out reason for elimination.

.11 Print heading for Case 3.

.12 Find out which parameters are eliminated.

.13 After a certain number of lines are printed out the output is started on a new page.

.14 Print out reason for elimination.

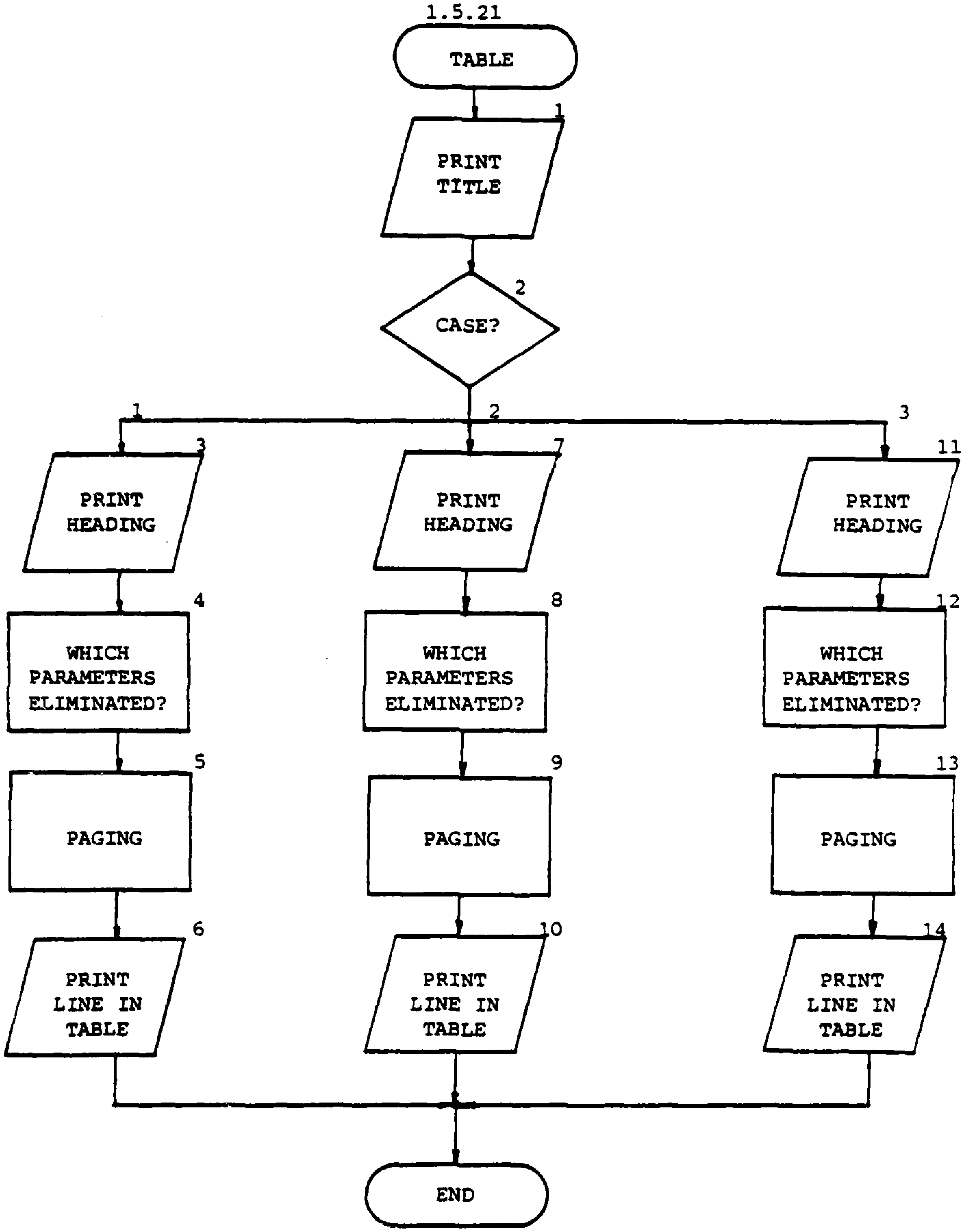

1.5.21
TABLE
1
PRINT TITLE
2
CASE?
1
2
3
3
PRINT HEADING
4
WHICH PARAMETERS ELIMINATED?
5
PAGING
6
PRINT LINE IN TABLE
7
PRINT HEADING
8
WHICH PARAMETERS ELIMINATED?
9
PAGING
10
PRINT LINE IN TABLE
11
PRINT HEADING
12
WHICH PARAMETERS ELIMINATED?
13
PAGING
14
PRINT LINE IN TABLE
END

Chart No. 1.6
Module Name INVRT

(1.6) INVeRT the Parameter Data

This module inverts indicated parameter data. The parameter data must be such that the lowest value of the parameter data is the "best" data.

.1 Rewind PP and VPARM files.

.2 Initialize VPARAM array to zero.

.3 Set up do-loop.

.4 Test to see if INVERT is zero.

.5 If no, then set up do-loop.

.6 Read in a line of parameter data from the data file.

.7 Set up do-loop to check data for every system.

.8 Initialize BIG to zero.

.9-.11 Find the largest value among the system or subsystems for that parameter.

.12 Set up do-loop.

.13 If the parameter data equals zero it is considered blank and skips over calculation.

.14 The parameter data is inverted by dividing the largest value by each system's or subsystem's parameter data.

.15 After the data has been inverted then write the data out on to the VPARM data file.

.16-.18 If the parameter data for that parameter is not to be inverted then write out the parameter data to the VPARM data file.

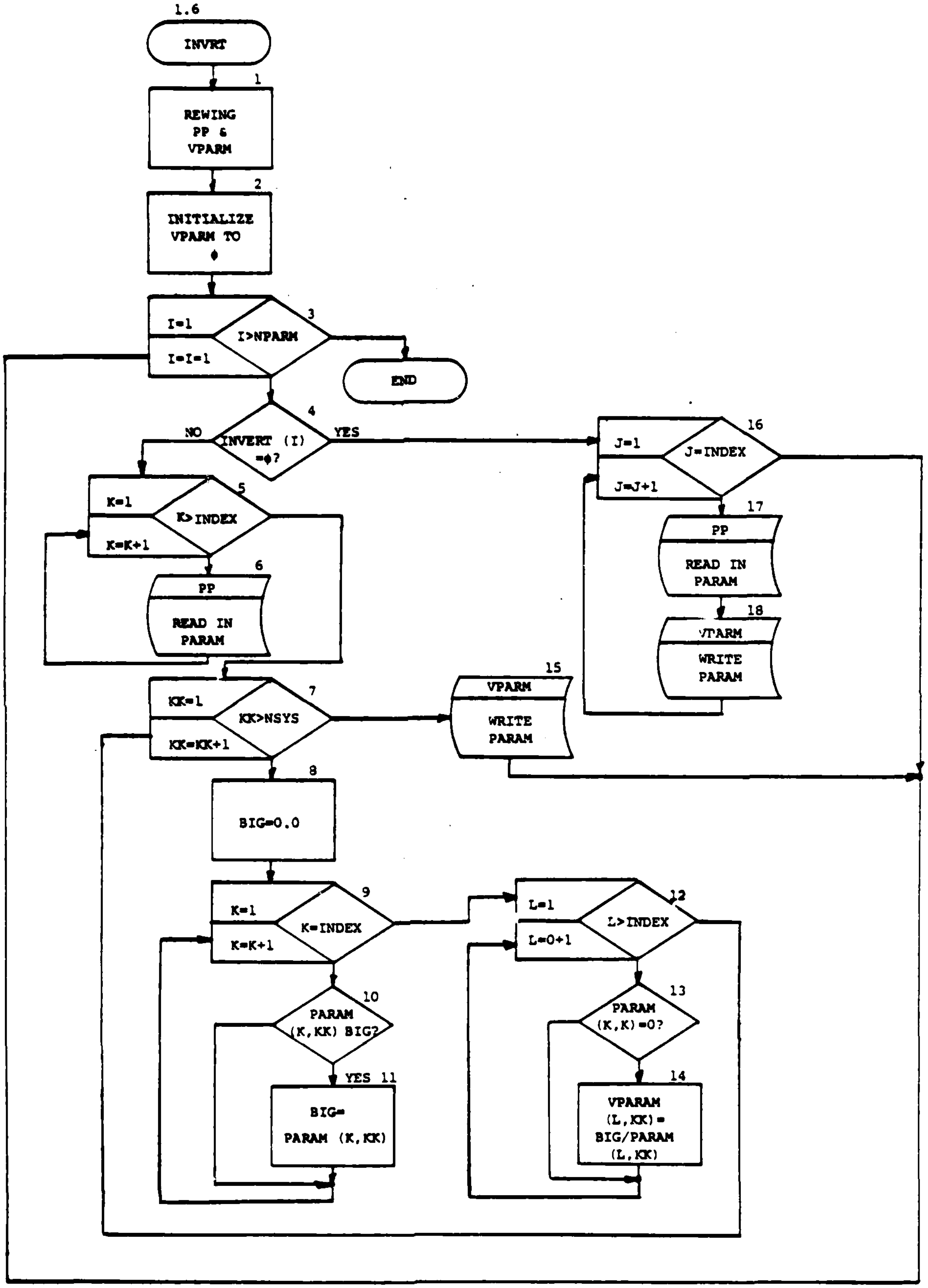

1.6
INVRT
1
REWING
PP &
VPARM
2
INITIALIZE
VPARM TO
ϕ
3
I=1
I>NPARM
I=I=1
END
4
NO
INVERT (I)
=ϕ?
YES
5
K=1
K>INDEX
K=K+1
6
PP
READ IN
PARAM
7
KK=1
KK>NSYS
KK=KK+1
8
BIG=0.0
9
K=1
K=INDEX
K=K+1
10
PARAM
(K,KK) BIG?
YES 11
BIG=
PARAM (K,KK)
12
L=1
L>INDEX
L=0+1
13
PARAM
(K,K)=0?
14
VPARAM
(L,KK)=
BIG/PARAM
(L,KK)
15
VPARM
WRITE
PARAM
16
J=1
J=INDEX
J=J+1
17
PP
READ IN
PARAM
18
VPARM
WRITE
PARAM

Chart No. 1.7
Module Name UTILT

(1.7) Calculate the UTILiTy values

This module determines the best system or subsystem based on the highest utility value. See Appendix 7.3 for more information.

.1 The RATING values are normalized.

.2-.3 Read in parameter values from file VPARM.

.4-.8 Eliminate parameter data systems that have been eliminated.

.9-.10 Determine the smallest parameter value for each parameter between the systems or subsystems.

.11-.12 Determine the biggest parameter value for each parameter between the systems or subsystems.

.13-.14 If any parameter data is equal to zero skip over calculations.

.15-.18 Calculate the utility value using the largest and smallest value.

.19 Calculate the rated utility value using the RATING value.

.20 Add the rated utility values for each system or subsystem.

.21 Print headings.

.22-.23 Call overlay containing module OUTPUT that prints table.

.24 Write system values out on file SYSNUM.

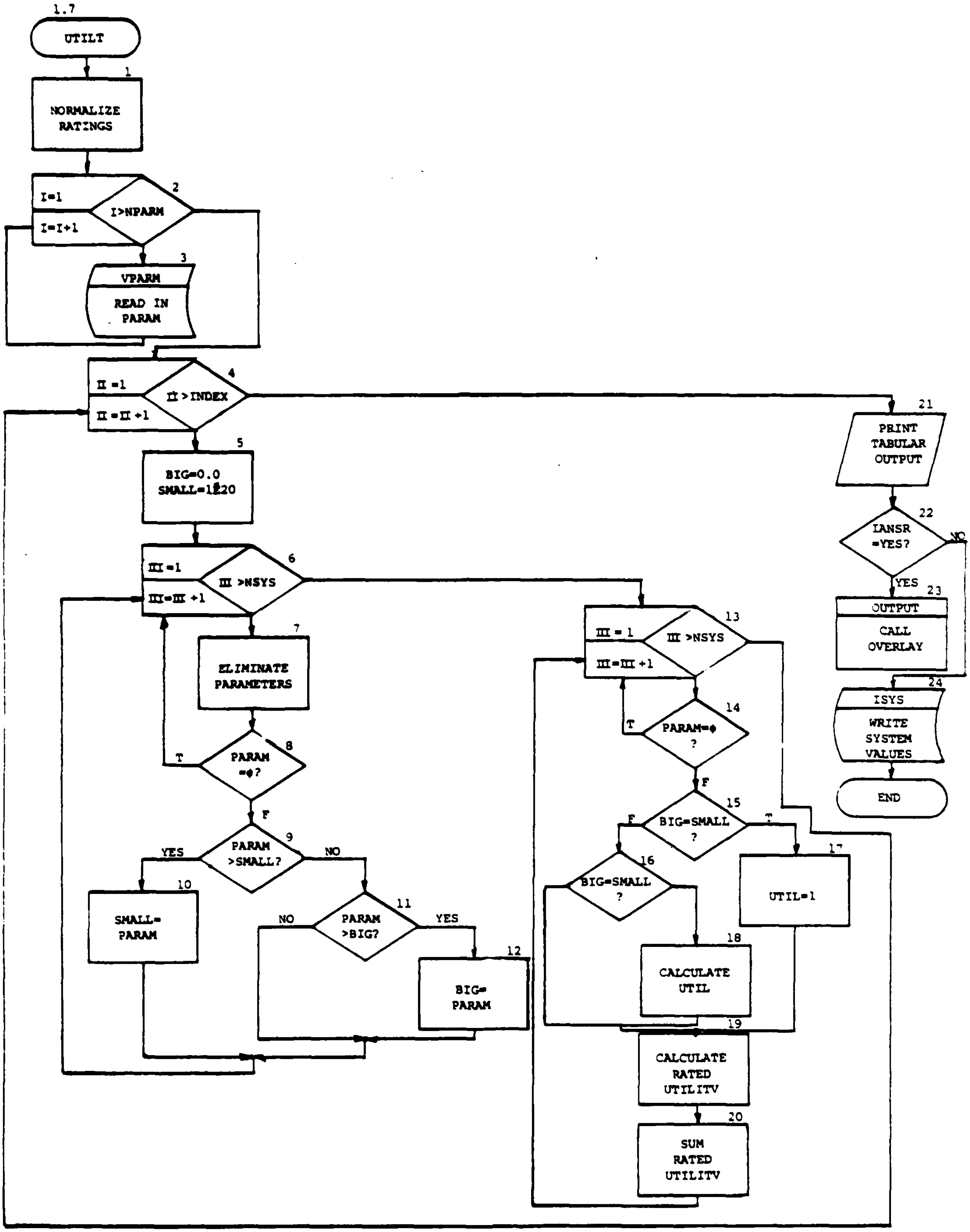

1.7
UTILT
1
NORMALIZE RATINGS
2
I=1
I=I+1
I>NPARM
3
VPARM
READ IN PARAM
4
II =1
II =II +1
II > INDEX
5
BIG=0.0
SMALL=1E20
6
III =1
III=III +1
III >NSYS
7
ELIMINATE PARAMETERS
8
T
PARAM =φ?
F
9
PARAM >SMALL?
YES
NO
10
SMALL= PARAM
11
PARAM >BIG?
NO
YES
12
BIG= PARAM
13
III = 1
III=III +1
III >NSYS
14
PARAM=φ ?
T
F
15
BIG=SMALL ?
F
T
16
BIG=SMALL ?
17
UTIL=1
18
CALCULATE UTIL
19
CALCULATE RATED UTILITV
20
SUM RATED UTILITV
21
PRINT TABULAR OUTPUT
22
IANSR =YES?
NO
YES
23
OUTPUT
CALL OVERLAY
24
ISYS
WRITE SYSTEM VALUES
END

Chart No. 1.7.23
Module Name OUTPUT

(1.7.23) Tabular OUTPUT

This module prints the system values calculated from the utility values that determines the "best" system or subsystem.

.1 Print headings.

.2 SYSDSN indicates how the problem is structured (Case).

.3-.4 Print table.

.5-.6 Print table.

.7 After a number of lines start a new page.

.8-.9 Print table.

.10 After a number of lines start a new page.

1.7.23

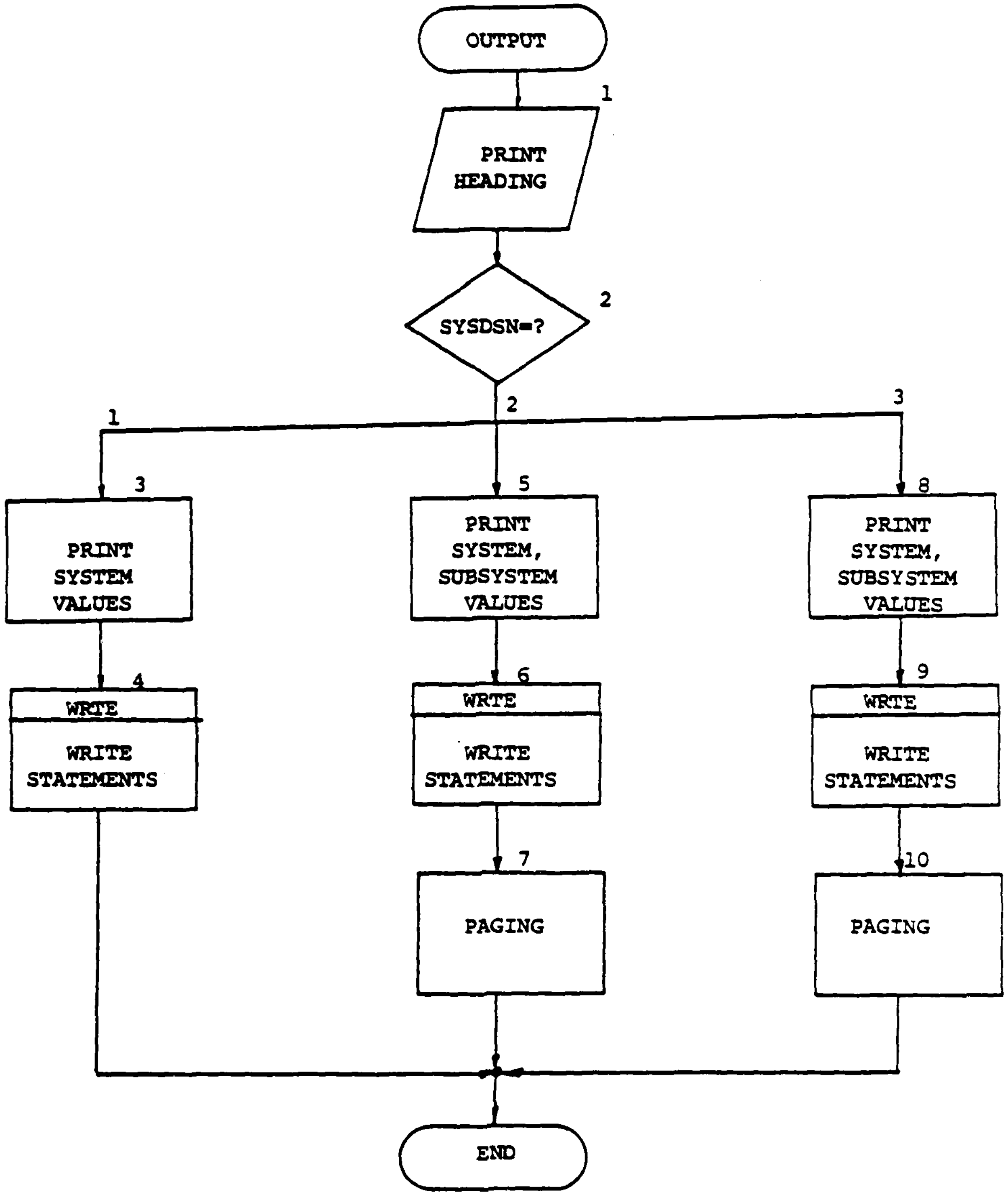

OUTPUT
1
PRINT HEADING
2
SYSDSN=?
1
2
3
3
PRINT SYSTEM VALUES
4
WRTE
WRITE STATEMENTS
5
PRINT SYSTEM, SUBSYSTEM VALUES
6
WRTE
WRITE STATEMENTS
7
PAGING
8
PRINT SYSTEM, SUBSYSTEM VALUES
9
WRTE
WRITE STATEMENTS
10
PAGING
END

Chart No. 1.7.23.4
Module Name WRTE

(1.7.23.4) WRiTE out system values

This module contains the write and format statements for the utility table.

.1 Choose appropriate write and format statement dependent on the number of systems, NSYS.

.2 Print heading.

.3 Print the normalized system values, SYSNRM and the optimum system.

1.7.23.4

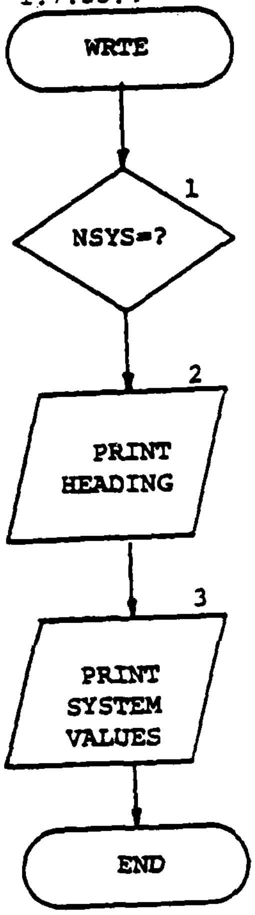


Chart No. 1.8
Module Name ANLYS

(1.8) ANaLYSis

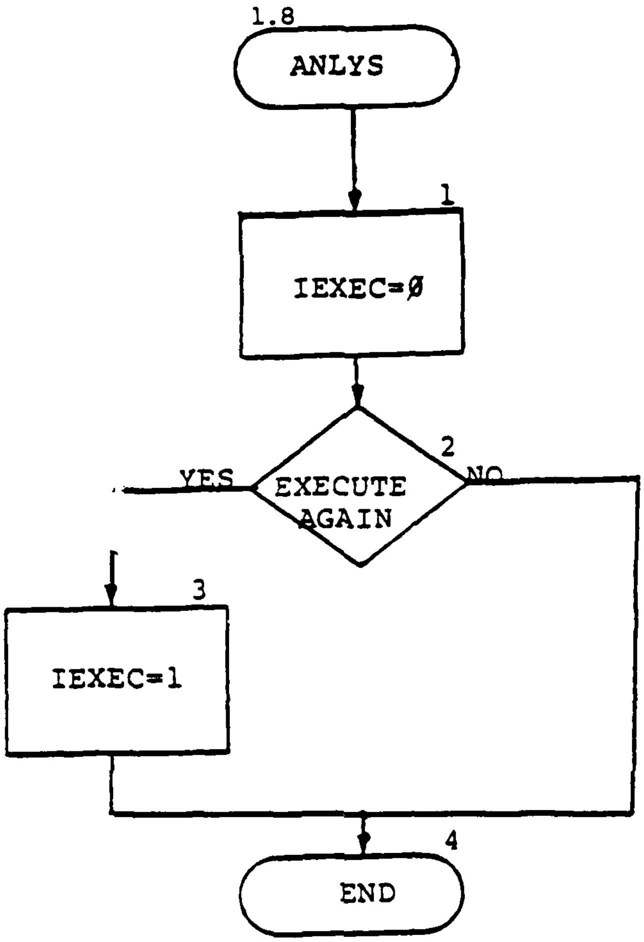
This module allows the user to execute the program over and over again, this is useful if one is performing an uncertainty analysis.

.1 Set IEXEC to zero.

.2 Ask the user if he or she wishes to execute the program again.

.3 If yes, then set IEXEC to zero.

.4 Return to the main overlay.


1.8
ANLYS
1
IEXEC=Ø
2
YES
EXECUTE AGAIN
NO
3
IEXEC=1
4
END

APPENDIX H--REFERENCES

APPENDIX H REFERENCES

1. FORTRAN Extended Version 4 Reference Manual, Control Data Corp., Sunnyvale, CA, 1978.

2. INTERCOM Version 5 Reference Manual, Control Data Corp., Sunnyvale, CA, 1980.

3. Introduction to ASD Computer Center, Wright-Patterson Air Force Base, OH, September, 1979.

4. NOS/BE Version 1 Reference Manual, Control Data Corp., Sunnyvale, CA, 1978.

5. Standardized Development of Computer Software. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1977.

6. Standardized Development of Computer Software, Part II, Standards. Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1979.

7. Van Tassel, Dennie, Program Style, Design, Efficiency, Debugging, and Testing. Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1978.

8. TEKTRONIX/PLOT-10 Terminal Control System.Tektronix, Inc., Beaverton,Oregon, 1973.

9. TEKTRONIX/PLOT-10 Advanced Graphing II, Tektronix, Inc., Beaverton,Oregon, 1973.

APPENDIX I GLOSSARY

APPENDIX I GLOSSARY

This is a listing which contains the names of program modules, variables, constants, and any special terms used in this document.

ABV The array that contains the upper limit for the parameter value.

AVE A variable that indicates the average value of the ratings according to scenario.

BELW The array that contains the lower limit for the parameter value.

BIG Indicates the biggest value.

CHPRM The integer array that contains the chosen parameters.

DBNAME Data base name; an integer array that contains the alphanumeric name of the PP data base.

ELIM The array that contains the parameter numbers that are to be eliminated.

HIR The array that contains the higher limit for the parameter value

IADD An integer variable that is used as a command to indicate the add mode.

IANSR The integer variable that indicates a yes or no answer.

IBAUD The integer value indicating the baud rate to the TEKTRONIX PLOT-10 software.

IBLANK An integer value that contains the blank character.

ICHAR An integer value that contains alphanumeric characters.

ICHARA An integer value that contains the alphanumeric character "A".

ICHARB An integer value that contains the alphanumeric character "B".

ICHOIC The integer value that indicates the choice of scenario.

ICOUNT The integer variable that counts the number of times the parameter is chosen.

ICNT The integer variable that counts the number of times the parameter is chosen.

ICRTE Integer variable that is used as a command to indicate the create mode.

IDUM1 An integer unit number for I/O for the file DUM1.

IDUM2 An integer unit number for I/O for the file DUM2.

IEND An integer variable that is used as a command to indicate the end of the program.

IEXEC An integer variable that indicates whether or not the program should execute again.

IHDR An integer unit number for I/O for the file HEADER.

ILIST An integer variable that is used as a command to indicate the list mode.

IMNIN The integer variable that is used as a command to indicate the manual input of the data.

INDEX An integer value used in INDEX arrays. If SYSDSN=1, INDEX=1; if SYSDSN=2, INDEX=NSUB1; if SYSDSN=3, INDEX=NSUB1*NSUB2.

INDEX1 The integer value for indexing.

INDICE The integer value that holds the value for an indice.

INO An integer value that contains the character no.

INVERT The inverted parameter indicator which is a binary 1, if the parameter is to be inverted; 0, if not.

IOPT An integer value that indicates which optimal system has been chosen.

IPP An integer unit number for I/O for the file PP.

IPPH An integer unit number for I/O for the PP part of the file HEADER.

IQUALT An integer array that contains the alphanumeric names for the rated parameters.

IRANGE The integer array that contains the chosen ratings for the rated parameter.

IRNG An integer value that indicates if range of elimination is above, below, or in between the parameter.

ISCEN The integer variable that indicates the number of scenarios.

ISWNO An integer array that contains a 1 if the parameter has no limits and 0 if it does have limits.

ISYS An integer unit number for I/O for the SYSNAM file.

ITTYIN An integer unit number for the terminal input.

ITYOUT An integer unit number for the terminal output.

IUPP An integer unit number for I/O for the file UPP.

IUPPH An integer unit number for I/O for the UPP part of the file HEADER.

IVBIN An integer value to test if the parameter has already been eliminated.

IVPARM An integer unit number for I/O for the VPARAM file.

IYES An integer value that contains the character yes.

JTERM An integer value signifying terminal type to the TEKTRONIX PLOT-10 software.

LINE The integer variable that counts the number of lines of output.

MATRIX The array that contains 0 and 1 values. A 0 value indicates that a parameter is to be eliminated. It is used to multiply the PARAM array.

NCALL The integer value that indicates the value for the indice when new scenarios are to be added.

NOLD An integer value that indicates the value for the indice when new scenarios are to be added.

NOPRM The number of parameters chosen to participate in the decision process.

NPAGE The integer value that contains the number of pages.

NPARM Number of parameters; an integer value that indicates the number of parameters.

NSCEN Number of scenarios; an integer value that indicates the number of scenarios.

NSUB1 Number of subsystems level 1; an integer value that indicates the number of level 1 subsystems.

NSUB2 Number of subsystems level 2; an integer value that indicates the largest number of level 2 subsystems for each level 1 subsystem.

NSYS Number of systems; an integer value that shows the number of systems.

NUM Numerical parameter which is given a binary value of 1, if numerical parameter; 0, if not.

PARNAM Parameter names; an integer array that contains the alphanumeric names of the parameters.

PAVE The array of the averages of the ratings.

PSUM A variable used to sum up the rating values for each parameter.

RATED Rated parameter; binary-defined as 1 if rated parameter; 0, if not.

RATING Ratings; an array that contains the user's ratings.

RCALL The real value of NCALL.

RLOWR The array that contains the lower limit for the parameter value.

RSCEN Real number of scenarios; the real value of NSCEN.

RTD The array that contains the chosen ratings for the rated parameter.

RTING Common block label.

SB1SET Subsystem level 1 setname; an integer array that contains the setname of the subsystem level 1 setname.

SB2SET Subsystem level 2 setname; an integer array that contains the setname of the subsystem level 2 setname.

SCNDSC Scenario descriptions; an integer array that contains the alphanumeric names of the scenarios.

SMALL Indicates the smallest value.

SUB1NM Subsystem level 1 names; an integer array that contains the alphanumeric names of the level 1 subsystems.

SUB2NM Subsystem level 2 names; an integer array that contains the alphanumeric names of the level 2 subsystems.

SUM An array used to sum up the ratings by scenarios.

SUMM Used to sum rating values.

SW1 A Boolean variable.

SW2 A Boolean variable.

SYSDSN System design indicator; an integer value that indicates the description of the problem.

1--indicates systems to be included.
2--indicates systems and level 1 subsystems.
3--indicates systems and levels 1 and 2 subsystems.

SYSNAM System names; an integer array containing the alphanumeric names of the systems.

SYSNRM System values normalized; an array that contains the normalized system values that indicated the relative optimal system.

SYSSET System setname; an integer array containing the setname of the systems.

VPARAM The array that contains the inverted parameters.

UTIL The array that contains the utility values for the systems and subsystems.

YN Qualitative parameter indicator; a binary 1 indicates, yes, the system or subsystems have that quality; a binary 0 indicates, no, the quality is not present.

APPENDIX J - LISTINGS

PROCEDURE FILE PPROC1

```
.PROC,PPPP,FHDR,FPP.
REQUEST,FHDR,*PF.
REQUEST,FPP,*PF.
ATTACH,TEKLIB,TEKLIB,SN=ASD,ID=LIBRARY,CY=999.
LIBRARY,TEKLIB.
ATTACH,PPP,PPP,CY=1.
PPP.
REWIND,HEADER.
REWIND,PP.
COPY,HEADER,FHDR.
COPY,PP,FPP.
RETURN,HEADER,PP,PPP,TEKLIB.
```

PROCEDURE FILE PPROC2

```
.PROC,PPPP,FHDR,CY1,FPP,CY2.
ATTACH,HEADER,FHDR,CY=CY1.
ATTACH,PP,FPP,CY=CY2.
ATTACH,PPP,PPP,CY=1.
PPP.
RETURN,PPP,PP,HEADER.
```

PROCEDURE FILE UPROC1

```
.PROC,UPPPP,OLD1,CY1,OLD2,CY2,NEW1,NEW2.
ATTACH,HDP,OLD1,CY=CY1.
ATTACH,UPP,OLD2,CY=CY2.
ATTACH,UPPP,UPPP,CY=1.
ATTACH,TEKLIB,TEKLIB,ID=LIBRARY,SN=ASD,CY=999.
LIBRAPY,TEKLIB.
REQUEST,NEW1,*PF.
REQUEST,NEW2,*PF.
UPPP.
REWIND,DUM1.
REWIND,DUM2.
COPY,DUM1,NEW1.
COPY,DUM2,NEW2.
RETURN,HDR,UPP,UPPP,DUM1,DUM2.
```

PROCEDURE FILE UPROC2

```
.PROC,UPPPP,OLD1,CY1,NEW1,NEW2.
ATTACH,HDR,OLD1,CY=CY1.
REQUEST,NEW1,*PF.
REQUEST,NEW2,*PF.
ATTACH,UPPP,UPPP,CY=1.
ATTACH,TEKLIB,TEKLIB,SN=ASD,ID=LIBRARY,CY=999.
LIBRARY,TEKLIB.
UPPP.
REWIND,DUM1.
REWIND,DUM2.
COPY,DUM1,NEW2.
COPY,DUM2,NEW1.
RETURN,HDR,UPP,UPPP,DUM1,DUM2,TEKLIB.
```

PROCEDURE FILE IPROC

```
.PROC,SSMPP,FL1,CY1,FL2,CY2,FL3,CY3.
ATTACH,PP,FL1,CY=CY1.
ATTACH,UPP,FL2,CY=CY2.
ATTACH,HEADER,FL3,CY=CY3.
ATTACH,SSMP,SSMP,CY=1.
SSMP.
RETURN,PP,UPP,SSMP,SSM,VPARM.
REWIND,SYSNUM.
ATTACH,TEKLIB,TEKLIB,SN=ASD,ID=LIBRARY,CY=999.
LIBRARY,TEKLIB.
ATTACH,GRAFX,GRAFX,CY=1.
GRAFX.
RETURN,GRF,GRAFX.
ATTACH,TGRAFX,TGRAFX,CY=1.
TGRAFX.
RETURN,TGRAFX,GRF,HEADER,SYSNUM,TEKLIB.
LIBRARY.
```

```
      PROGRAM PPP(INPUT,OUTPUT,HEADER,DUM,PP,TAPE10=HEADER,TAPE11=PP,
     &TAPE2=OUTPUT,TAPE5=INPUT,TAPE13=DUM)
C*****************************************************************
C                    PARAMETER PACKAGE PROGRAM
C                      DIRECTS THE EXECUTION
C                          OF THE CHOSEN
C                           SUBROUTINE
C*****************************************************************

      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,IPP,IDUM
      COMMON/DB/DBNAME(4)
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     &SYSSET(4),SB1SET(4),SB2SET(4),
     &SYSNAM(10,4),SUB1NM(20,4),SUB2NM(20,21,4),
     &PARNAM(40,4),NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     &RATED,YN,PARNAM
      DATA IEND/3HEND/,ILST/4HLIST/,ICRTE/4HCRTE/,
     &IMNIN/4HMNIN/
C
C     TEKTRONIX PAGING
      WRITE(ITYOUT,1)
      WRITE(ITYOUT,4)
      WRITE(ITYOUT,2)
      READ(ITTYIN,3)IANSR
C
100   LINE=34
      CALL PAGER (LINE,0)
      IF(IANSR.EQ.IEND) GO TO 1000
      IF(IANSR.EQ.ICRTE) CALL CREATE
C
C *** READ IN /HDR1/ ***
C
      REWIND IHDR
      CALL READR1
      IF (IANSR.EQ.IMNIN) CALL MANUAL
      IF (IANSR.EQ.ILST) CALL LIST
      WRITE(ITYOUT,2)
      READ(ITTYIN,3)IANSR
      GO TO 100
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT (1X//,1X,70(1H*),/,1X,1H*,22X,25HPARAMETER PACKAGE PROGRAM,
     & 21X,1H*,/,1X,70(1H*),///)
2     FORMAT (1X,10HCOMMAND-->)
3     FORMAT(A4)
4     FORMAT (1X,19HCOMMANDS AVAILABLE:,/,5X,
     & 28HCRTE - CREATES FILE OF NAMES,/,5X,
     & 49HMNIN - ALLOWS MANUAL ENTERING OF PARAMETER VALUES,/,5X,
     & 43HLIST - LISTS OUT NAMES AND PARAMETER VALUES,/,5X,
     & 19HEND  - ENDS PROGRAM,//)
1000  CONTINUE
      STOP
      END
C
C****************************************************************
      BLOCK DATA
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,IPP,IDUM
      DATA ITTYIN,ITYOUT,IHDR,IPP,IDUM/5,2,10,11,13/
      END
C****************************************************************
C
C
C****************************************************************
      SUBROUTINE CREATE
C
C        -CREATES FILE OF NAMES, HEADER
C
C****************************************************************
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,IPP,IDUM
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     &SYSSET(4),SB1SET(4),SB2SET(4),
     &SYSNAM(10,4),SUB1NM(20,4),SUB2NM(20,21,4),
     &PARNAM(40,4),NUM(40),RATED(40),YN(40),INVERT(40),
     &INDEX
C
      COMMON /DB/ DBNAME(4)
      INTEGER DBNAME,SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,
     &SUB1NM,SUB2NM,PARNAM,RATED,YN
      DATA SW1/0/,SW2/0/
      DATA INO/2HNO/,IYES/3HYES/
C
C *** READ IN DATA BASE NAMES ***
      WRITE(ITYOUT,1)
      READ(ITTYIN,2)(DBNAME(M),M=1,4)
C *** READ IN NUMBER OF SYSTEMS ***
      WRITE(ITYOUT,3)
      READ(ITTYIN,4)NSYS
C *** READ IN NUMBER OF LEVEL 1 SUBSYSTEMS ***
      WRITE(ITYOUT,5)
      READ(ITTYIN,4)NSUB1
      IF(NSUB1.EQ.0)SW1=1
C *** READ IN NUMBER OF LEVEL 2 SUBSYSTEMS ***
      WRITE(ITYOUT,6)
      READ(ITTYIN,4)NSUB2
      IF(NSUB2.EQ.0)SW2=1
C *** READ IN NUMBER OF PARAMETERS ***
      WRITE(ITYOUT,7)
      READ(ITTYIN,4)NPARM
C *** READ IN SYSTEM SETNAME AND SYSTEM NAMES ***
      WRITE(ITYOUT,8)
      READ(ITTYIN,2)(SYSSET(M),M=1,4)
      DO 100 I=1,NSYS
         WRITE(ITYOUT,9)(SYSSET(M),M=1,4),I
         READ(ITTYIN,2)(SYSNAM(I,M),M=1,4)
100   CONTINUE
```

```
      LINE=34
      CALL PAGER (LINE,0)
      IF(SW1.EQ.1)GO TO 210
C *** READ IN LEVEL 1 SUBSYSTEM SETNAME AND SUBSYSTEM NAMES ***
      WRITE(ITYOUT,10)
      READ(ITTYIN,2)(SB1SET(M),M=1,4)
      DO 200 I=1,NSUB1
         WRITE (ITYOUT,11) (SB1SET(M),M=1,4),I
         READ(ITTYIN,2)(SUB1NM(I,M),M=1,4)
200   CONTINUE
      IF(SW2.EQ.1) GO TO 210
C *** READ IN LEVEL 2 SUBSYSTEM SETNAME AND SUBSYSTEM NAMES ***
      WRITE(ITYOUT,12)
      READ(ITTYIN,2)(SB2SET(M),M=1,4)
      DO 300 I=1,NSUB1
         DO 300 I1=1,NSUB2
            WRITE (ITYOUT,13) (SB2SET(M),M=1,4),
     &      (SUB1NM(I,M),M=1,4),I1
            READ (ITTYIN,2) (SUB2NM(I,I1,M),M=1,4)
300   CONTINUE
      LINE=34
      CALL PAGER (LINE,0)
C *** READ IN PARAMETER NAMES ***
210   DO 400 I=1,NPARM
         WRITE (ITYOUT,14) I
         READ(ITTYIN,2)(PARNAM(I,M),M=1,4)
400   CONTINUE
      LINE=34
      CALL PAGER (LINE,0)
      DO 501 I=1,NPARM
         RATED(I)=0
         YN(I)=0
         NUM(I)=0
         INVERT(I)=0
501   CONTINUE
C *** WHAT TYPE PARAMETER AND DOES IT NEED TO BE INVERTED ***
      DO 500 I=1,NPARM
111   CALL PAGER (LINE,2)
         WRITE(ITYOUT,15)(PARNAM(I,M),M=1,4)
         READ(ITTYIN,16)NANSR
      LINE=LINE+2
         IF(NANSR.EQ.INO) GO TO 515
         NUM(I)=1
         GO TO 550
515   CALL PAGER (LINE,2)
         WRITE(ITYOUT,17) (PARNAM(I,M),M=1,4)
         READ(ITTYIN,16)KANSR
      LINE=LINE+2
         IF(KANSR.EQ.INO) GO TO 520
         RATED(I)=1
         GO TO 560
520   CALL PAGER (LINE,2)
         WRITE(ITYOUT,18) (PARNAM(I,M),M=1,4)
         READ(ITTYIN,16)LANSR
      LINE=LINE+2
         IF(LANSR.EQ.INO) GO TO 525
         YN(I)=1
         GO TO 560
525   CALL PAGER (LINE,2)
         WRITE(ITYOUT,19)
      LINE=LINE+2
         GO TO 111
550   CALL PAGER (LINE,4)
         WRITE(ITYOUT,20)(PARNAM(I,M),M=1,4)
         READ(ITTYIN,16)MANSR
         IF(MANSR.EQ.IYES)INVERT(I)=1
      LINE=LINE+4
560      NANSR=0
         KANSR=0
         LANSR=0
         MANSR=0
500   CONTINUE
C
C *** INPUT INTO HEADER ***
C
      REWIND IHDR
      WRITE(IHDR,23)(DBNAME(M),M=1,4)
      IF(SW1.EQ.1.AND.SW2.EQ.1)SYSDSN=1
      IF(SW1.EQ.0.AND.SW2.EQ.1)SYSDSN=2
      IF(SW1.EQ.0.AND.SW2.EQ.0)SYSDSN=3
      WRITE(IHDR,21)SYSDSN
      WRITE(IHDR,22)NSYS
      WRITE(IHDR,22)NSUB1
      WRITE(IHDR,22)NSUB2
      WRITE(IHDR,22)NPARM
      WRITE(IHDR,23)(SYSSET(M),M=1,4)
      IF(SYSDSN.GE.2)WRITE(IHDR,23)(SB1SET(M),M=1,4)
      IF(SYSDSN.EQ.3)WRITE(IHDR,23)(SB2SET(M),M=1,4)
      DO 600 I=1,NSYS
         WRITE(IHDR,23)(SYSNAM(I,J),J=1,4)
600   CONTINUE
      IF(SW1.EQ.1) GO TO 605
      DO 700 I=1,NSUB1
         WRITE(IHDR,23)(SUB1NM(I,J),J=1,4)
700   CONTINUE
      IF(SW2.EQ.1) GO TO 605
      DO 800 I=1,NSUB1
         DO 800 J=1,NSUB2
            WRITE(IHDR,23)(SUB2NM(I,J,M),M=1,4)
800   CONTINUE
605   DO 900 I=1,NPARM
         WRITE(IHDR,24)(PARNAM(I,J),J=1,4),NUM(I),RATED(I),YN(I),
     &   INVERT(I)
900   CONTINUE
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT(1X,35HENTER DATA BASE NAME (MAX 16 CHARS)/)
```

```
2      FORMAT(4A4)
3      FORMAT(1X,34HENTER NO. OF SYSTEMS (2 DIGIT NO.)/)
4      FORMAT(I2)
5      FORMAT(1X,45HENTER NO. OF LEVEL 1 SUBSYSTEMS (2 DIGIT NO.)/)
6      FORMAT(1X,45HENTER NO. OF LEVEL 2 SUBSYSTEMS (2 DIGIT NO.)/)
7      FORMAT(1X,37HENTER NO. OF PARAMETERS (2 DIGIT NO.)/)
8      FORMAT(1X,37HENTER SYSTEM SETNAME (MAX. 16 CHARS.)/)
9      FORMAT(1X,15HENTER NAME FOR ,4A4,5H NO. ,I2,16H (MAX. 16 CHARS)/)
10     FORMAT(1X,47HENTER LEVEL 1 SUBSYSTEM SETNAME (MAX. 16 CHARS)/)
11     FORMAT(1X,14HENTER NAME FOR,1X,4A4,6H, NO. ,I2,2X,
     & 16H(MAX. 16 CHARS.)/)
12     FORMAT(1X,38HENTER LEVEL 2 SUBSYSTEM SETNAME (MAX. ,
     & 9H16CHARS.)/)
13     FORMAT(1X,14HENTER NAME FOR,1X,4A4,3H , ,4A4,6H, NO. ,I2,2X,
     & 16H(MAX. 16 CHARS.)/)
14     FORMAT(1X,28HENTER NAME FOR PARAMETER NO.,I2,/)
15     FORMAT(1X,3HIS ,4A4,33H A NUMERICAL PARAMETER ? (YES/NO)/)
16     FORMAT(A3)
17     FORMAT (1X,3HIS ,4A4,29H A RATED PARAMETER ? (YES/NO)/)
18     FORMAT(1X 3HIS ,4A4,35H A QUALITATIVE PARAMETER ? (YES/NO)/)
19     FORMAT(1X,42HERROR -- PARAMETER MUST BE CLASSIFIED AS A,
     &30HNUMERIC, RATED, OR QUALITATIVE/1X,12HPARAMETER - ,
     &9HTRY AGAIN/)
20     FORMAT (1X,45HFOR NUMERICAL PARAMETERS, THE LOWEST VALUE IS,/,
     & 1X,28HCONSIDERED THE "BEST" VALUE.,/,1X,
     &32H DO YOU WISH TO INVERT THIS FOR ,4A4,11H ? (YES/NO)/)
21     FORMAT(I1)
22     FORMAT(I2)
23     FORMAT(4A4)
24     FORMAT(4A4,I1,I1,I1,I1)
       RETURN
       END
C
C************************************************************
       SUBROUTINE READR1
C
C        -READS IN HEADER FILE
C
C************************************************************
C
       COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,IPP,IDUM
       COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(4),
     & SB1SET(4),SB2SET(4),SYSNAM(10,4),SUB1NM(20,4),SUB2NM(20,21,4),
     &PARNAM(40,4),NUM(40),RATED(40),YN(40),INVERT(40),INDEX
       COMMON/DB/DBNAME(4)
       INTEGER DBNAME
       INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     &RATED,YN,PARNAM
C
C *** READ IN HEADER ***
       REWIND IHDR
C
       READ(IHDR,3)(DBNAME(M),M=1,4)
       READ(IHDR,1)SYSDSN
```

```
      READ(IHDR,2)NSYS
      READ(IHDR,2)NSUB1
      READ(IHDR,2)NSUB2
      READ(IHDR,2)NPARM
      READ(IHDR,3)(SYSSET(I),I=1,4)
      IF(SYSDSN.GE.2)READ(IHDR,3)(SB1SET(I),I=1,4)
      IF(SYSDSN.EQ.3)READ(IHDR,3)(SB2SET(I),I=1,4)
      DO 100 I=1,NSYS
      READ(IHDR,3)(SYSNAM(I,J),J=1,4)
100   CONTINUE
      IF(NSUB1.EQ.0) GO TO 400
      DO 200 I=1,NSUB1
      READ (IHDP,3)(SUB1NM(I,J),J=1,4)
200   CONTINUE
      IF(NSUB2.EQ.0) GO TO 400
      DO 300 K=1,NSUB1
      DO 301 I=1,NSUB2
      READ(IHDR,3)(SUB2NM(K,I,J),J=1,4)
301   CONTINUE
300   CONTINUE
400   CONTINUE
      DO 500 I=1,NPARM
      READ(IHDR,4)(PARNAM(I,J),J=1,4),NUM(I),RATED(I),YN(I),INVERT(I)
500   CONTINUE
C
C *** CALCULATE INDEX ***
C
      IF(NSUB1.EQ.0)GO TO 800
      IF(NSUB2.EQ.0)GO TO 900
      INDEX=NSUB1*NSUB2
      GO TO 1000
800   INDEX=1
      GO TO 1000
900   INDEX=NSUB1
1000  CONTINUE
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT (I1)
2     FORMAT (I2)
3     FORMAT (4A4)
4     FORMAT (4A4,I1,I1,I1,I1)
      RETURN
      END
C
C
C*******************************************************************
      SUBROUTINE MANUAL
C
C       - ALLOWS ENTERING OF PARAMETER VALUES, CREATES FILE PP
C
C*******************************************************************
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDR,IPP,IDUM
      COMMON /HDR1/ SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),SYSNAM(10,4),SUB1NM(20,4),
     & SUB2NM(20,21,4),PARNAM(40,4),NUM(40),RATED(40),YN(40),
     & INVERT(40),INDEX
      DIMENSION PARAM(85,10)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,RATED,YN
      DATA IBLANK/1H /
C
      REWIND IPP
      LINE=0
C
      GO TO (1000,2000,3000),SYSDSN
C
1000  DO 100 I=1,NPARM
         CALL PAGER (LINE,4)
      WRITE (ITYOUT,4) (PARNAM(I,M),M=1,4)
      IF (NUM(I).EQ.1) WRITE (ITYOUT,1)
      IF (RATED(I).EQ.1) WRITE (ITYOUT,2)
      IF (YN(I).EQ.1) WRITE (ITYOUT,3)
      LINE=LINE+4
      IF (RATED(I).EQ.1) LINE=LINE+1
      DO 150 J=1,NSYS
         CALL PAGER (LINE,2)
         WRITE (ITYOUT,5) (SYSNAM(J,M),M=1,4)
         READ (ITTYIN,*) PARAM(1,J)
         LINE=LINE+2
150   CONTINUE
      WRITE (IPP,*) (PARAM(1,J),J=1,NSYS)
100   CONTINUE
      GO TO 9000
C
C
2000  DO 200 I=1,NPARM
         CALL PAGER (LINE,4)
         WRITE (ITYOUT,4) (PARNAM(I,M),M=1,4)
         IF (YN(I).EQ.1) WRITE (ITYOUT,3)
         IF (RATED(I).EQ.1) WRITE (ITYOUT,2)
         IF (NUM(I).EQ.1) WRITE (ITYOUT,1)
         LINE=LINE+4
      IF (RATED(I).EQ.1) LINE=LINE+1
         DO 250 K=1,INDEX
            DO 250 J=1,NSYS
         CALL PAGER (LINE,2)
               WRITE (ITYOUT,5) (SYSNAM(J,M),M=1,4),
     &         (SUB1NM(K,M),M=1,4)
               READ (ITTYIN,*) PARAM(K,J)
            LINE=LINE+2
250         CONTINUE
            DO 260 K=1,INDEX
               WRITE (IPP,*) (PARAM(K,J),J=1,NSYS)
260      CONTINUE
200   CONTINUE
      GO TO 9000
```

```
C
C
3000  DO 300 I=1,NPARM
         CALL PAGER (LINE,4)
         WRITE (ITYOUT,4) (PARNAM(I,M),M=1,4)
         IF (NUM(I).EQ.1) WRITE (ITYOUT,1)
         IF (RATED(I).EQ.1) WRITE (ITYOUT,2)
         IF (YN(I).EQ.1) WRITE (ITYOUT,3)
      LINE=LINE+4
      IF (RATED(I).EQ.1) LINE=LINE+1
         DO 350 J=1,NSYS
      IND=0
            DO 350 K=1,NSUB1
               DO 350 L=1,NSUB2
                  CALL PAGER (LINE,2)
                  WRITE (ITYOUT,6) (SYSNAM(J,M),M=1,4),
     &            (SUB1NM(K,M),M=1,4),(SUB2NM(K,L,M),M=1,4)
               IND=IND+1
            READ (ITTYIN,*) PARAM (IND,J)
            LINE=LINE+2
350      CONTINUE
      DO 360 K=1,INDEX
         WRITE (IPP,*) (PARAM(K,JJ),JJ=1,NSYS)
360   CONTINUE
300   CONTINUE
9000  CONTINUE
C
C*** FORMAT STATEMENTS ***
C
1     FORMAT (1H ,44HTHIS IS A NUMERIC PARAMETER - ENTER A NUMBER/)
2     FORMAT (1H ,44HTHIS IS A RATED PARAMETER - RATE AS FOLLOWS:,/,
     & 1X,48H1-EXCELLENT, 2-GOOD, 3-FAIR, 4-POOR, 5-VERY POOR,/)
3     FORMAT (1H ,50HTHIS IS A QUALITATIVE PARAMETER - ENTER 1 FOR YES,
     & 9H 0 FOR NO,/)
4     FORMAT (1H ,4A4,/)
5     FORMAT (1X,4A4,4H -- ,4A4,/)
6     FORMAT (1X,4A4,4H -- ,4A4,4H -- ,4A4,/)
C
      RETURN
      END
C
C*************************************************************
      SUBROUTINE LIST
C
C        - PRINTS OUT PARAMETERS AND THEIR VALUES
C
C*************************************************************
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDR,IPP,IDUM
      COMMON /HDR1/ SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(4),SB1SET(4),
     & SB2SET(4),SYSNAM(10,4),SUB1NM(20,4),SUB2NM(20,21,4),
     & PARNAM(40,4),NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,RATED,YN,PARNAM
```

```
C
      REWIND IPP
C
      LIM=18
      IF (NSYS.LE.9)LIM=LIM-3
      IF (NSYS.LE.6) LIM=LIM-3
      IF (NSYS.LE.3) LIM=LIM-3
C
      GO TO (1000,2000,3000), SYSDSN
C
1000  CONTINUE
      II=1
      DO 100 I=1,NPARM
      LINE=34
      IF (I.NE.1) CALL PAGER (LINE,0)
         WRITE (ITYOUT,2) (PARNAM(I,M),M=1,4)
         CALL WRTOUT (I,II)
      WRITE (ITYOUT,4)
100   CONTINUE
C
      RETURN
C
2000  CONTINUE
      DO 200 I=1,NPARM
      LINE=34
      CALL PAGER (LINE,0)
         WRITE (ITYOUT,2) (PARNAM(I,M),M=1,4)
      LINE=LINE+5
         DO 210 II=1,INDEX
         CALL PAGER (LINE,LIM)
           IF (LINE.EQ.0) WRITE (ITYOUT,1)
           IF (LINE.EQ.0) LINE=1
            WRITE (ITYOUT,3) (SUBINM(II,M),M=1,4)
            CALL WRTOUT (I,II)
            WRITE (ITYOUT,4)
         LINE=LINE+LIM
210      CONTINUE
200   CONTINUE
C
C
      RETURN
C
3000  CONTINUE
      LIM=LIM+5
      DO 300 I=1,NPARM
      LINE=34
      CALL PAGER (LINE,0)
         WRITE (ITYOUT,2) (PARNAM(I,M),M=1,4)
      LINE=LINE+5
         INDX=0
         DO 310 J=1,NSUB1
            CALL PAGER (LINE,LIM)
              IF (LINE.EQ.0) WRITE (ITYOUT,1)
              IF (LINE.EQ.0) LINE=1
            WRITE (ITYOUT,3) (SUB1NM(J,M),M=1,4)
            DO 320 K=1,NSUB2
               WRITE (ITYOUT,3) (SUB2NM(J,K,M),M=1,4)
               INDX=INDX+1
               II=INDX
               CALL WRTOUT(I,II)
               WRITE (ITYOUT,4)
            LINE=LINE+LIM
320         CONTINUE
310      CONTINUE
300   CONTINUE
C
C
      RETURN
C
C*** FORMAT STATEMENTS ***
C
1     FORMAT (1X,70(1H*))
2     FORMAT (1X,70(1H*)/1X,1H*,68X,1H*/1X,1H*,26X,4A4,26X,1H*/
     & 1X,1H*,68X,1H*/1X,70(1H*))
3     FORMAT (1X,1H*,68X,1H*/1X,1H*,26X,4A4,26X,1H*/
     & 1X,1H*,68X,1H*/1X,70(1H*))
4     FORMAT (1X,1H*,68X,1H*/1X,70(1H*))
C
      END
C
C
C*********************************************************************
      SUBPOUTINE WRTOUT (I,II)
C
C       - PERFORMS PART OF LISTING CHORES
C
C*********************************************************************
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDP,IPP,IDUM
      COMMON /HDR1/ SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(4),
     & SB1SET(4),SB2SET(4),SYSNAM(10,4),SUB1NM(20,4),
     & SUB2NM(20,21,4),PARNAM(40,4),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      DIMENSION PARAM(85,10),IQUALT(5,3),IPARAM(10)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUP2NM,RATED,YN,PARNAM,PARAM1(10)
C
      DATA IQUALT(1,1)/4HEXCE/,IQUALT(1,2)/4HLLEN/,IQUALT(1,3)/4HT   /
      DATA IQUALT(2,1)/4HGOOD/,IQUALT(2,2)/4H    /,IQUALT(2,3)/4H    /
      DATA IQUALT(3,1)/4HFAIR/,IQUALT(3,2)/4H    /,IQUALT(3,3)/4H    /
      DATA IQUALT(4,1)/4HPOOR/,IQUALT(4,2)/4H    /,IQUALT(4,3)/4H    /
      DATA IQUALT(5,1)/4HVEPY/,IQUALT(5,2)/4H POO/,IQUALT(5,3)/4HP   /
      DATA IYES/3HYES/,INO/2HNO/
C
      READ (IPP,*) (PARAM(II,MT),MT=1,NSYS)
      DO 9000 J=1,NSYS
            IPARAM(J)=PARAM(II,J)
9000  CONTINUE
```

```
      GO TO (1000,1100,1200,1300,1400,1500,1600,1700,1800,1900),NSYS
C
1000  RETURN
C
1100  IF (NUM(I).EQ.1) GO TO 1110
      IF (RATED(I).EQ.1) GO TO 1120
      IF (YN(I).EQ.1) GO TO 1130
      RETURN
1110  WRITE (ITYOUT,1) ((SYSNAM(M,MM),MM=1,4),M=1,NSYS),
     & (PARAM(II,ML),ML=1,NSYS)
      RETURN
1120  WRITE (ITYOUT,2) ((SYSNAM(M,MM),MM=1,4),M=1,NSYS),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,NSYS)
      RETURN
1130  DO 1131 L=1,NSYS
          IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
          IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
1131  CONTINUE
      WRITE (ITYOUT,3) ((SYSNAM(M,MM),MM=1,4),M=1,NSYS),
     & (PARAM1(L),L=1,NSYS)
      RETURN
C
1200  IF(NUM(I).EQ.1) GO TO 1210
      IF (RATED(I).EQ.1) GO TO 1220
      IF (YN(I).EQ.1) GO TO 1230
      RETURN
1210  WRITE (ITYOUT,4) ((SYSNAM(M,MM),MM=1,4),M=1,NSYS),
     & (PARAM(II,ML),ML=1,NSYS)
      RETURN
1220  WRITE (ITYOUT,5) ((SYSNAM(M,MM),MM=1,4),M=1,NSYS),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,NSYS)
      RETURN
1230  DO 1231 L=1,NSYS
          IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
          IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
1231  CONTINUE
      WRITE (ITYOUT,6) ((SYSNAM(M,MM),MM=1,4),M=1,NSYS),
     & (PARAM1(L),L=1,NSYS)
      RETURN
C
1300  IF (NUM(I).EQ.1) GO TO 1310
      IF (RATED(I).EQ.1) GO TO 1320
      IF (YN(I).EQ.1) GO TO 1330
      RETURN
1310  WRITE (ITYOUT,7) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM(II,ML),ML=1,3),(SYSNAM(4,MM),MM=1,4),
     & PAPAM(II,4)
      RETURN
1320  WRITE (ITYOUT,8) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,3),
     & (SYSNAM(4,MM),MM=1,4),(IQUALT(IPARAM(4),J),J=1,3)
      RETURN
1330  DO 1331 L=1,NSYS
          IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
          IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
1331  CONTINUE
      WRITE (ITYOUT,9) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM1(L),L=1,3),(SYSNAM(4,MM),MM=1,4),
     & PARAM1(4)
      RETURN
C
1400  IF (NUM(I).EQ.1) GO TO 1410
      IF (RATED(I).EQ.1) GO TO 1420
      IF (YN(I).EQ.1) GO TO 1430
      RETURN
1410  WRITE (ITYOUT,10) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM(II,ML),ML=1,3),((SYSNAM(M,MM),MM=1,4),M=4,5),
     & (PARAM(II,ML),ML=4,5)
      RETURN
1420  WRITE (ITYOUT,11) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,3),
     & ((SYSNAM(M,MM),MM=1,4),M=4,5),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=4,5)
      RETURN
1430  DO 1431 L=1,NSYS
          IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
          IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
1431  CONTINUE
      WRITE (ITYOUT,12) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM1(L),L=1,3),((SYSNAM(M,MM),MM=1,4),M=4,5),
     & (PARAM1(L),L=4,5)
      RETURN
C
1500  IF (NUM(I).EQ.1) GO TO 1510
      IF (RATED(I).EQ.1) GO TO 1520
      IF (YN(I).EQ.1) GO TO 1530
      RETURN
1510  WRITE (ITYOUT,13) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM(II,ML),ML=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM(II,ML),ML=4,6)
      RETURN
1520  WRITE (ITYOUT,14) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,3),
     & ((SYSNAM(M,MM),MM=1,4),M=4,6),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=4,6)
      RETURN
1530  DO 1531 L=1,NSYS
          IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
          IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
1531  CONTINUE
      WRITE (ITYOUT,15) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM1(L),L=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM1(L),L=4,6)
      RETURN
C
1600  IF (NUM(I).EQ.1) GO TO 1610
      IF (RATED(I).EQ.1) GO TO 1620
      IF (YN(I).EQ.1) GO TO 1630
      RETURN
1610  WRITE (ITYOUT,16) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM(II,ML),ML=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM(II,ML),ML=4,6),(SYSNAM(7,MM),MM=1,4),
     & PARAM(II,7)
      RETURN
1620  WRITE (ITYOUT,17) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,3),
     & ((SYSNAM(M,MM),MM=1,4),M=4,6),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=4,6),
     & (SYSNAM(7,MM),MM=1,4),(IQUALT(IPARAM(7),J),J=1,3)
      RETURN
1630  DO 1631 L=1,NSYS
      IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
      IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
1631  CONTINUE
      WRITE (ITYOUT,18) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM1(L),L=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM1(L),L=4,6),(SYSNAM(7,MM),MM=1,4),
     & PARAM1(7)
      RETURN
C
1700  IF (NUM(I).EQ.1) GO TO 1710
      IF (RATED(I).EQ.1) GO TO 1720
      IF (YN(I).EQ.1) GO TO 1730
      RETURN
1710  WRITE (ITYOUT,19) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM(II,ML),ML=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM(II,ML),ML=4,6),((SYSNAM(M,MM),MM=1,4),M=7,8),
     & (PARAM(II,ML),ML=7,8)
      RETURN
1720  WRITE (ITYOUT,20) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,3),
     & ((SYSNAM(M,MM),MM=1,4),M=4,6),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=4,6),
     & ((SYSNAM(M,MM),MM=1,4),M=7,8),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=7,8)
      RETURN
1730  DO 1731 L=1,NSYS
      IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
      IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
1731  CONTINUE
      WRITE (ITYOUT,21) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM1(L),L=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM1(L),L=4,6),((SYSNAM(M,MM),MM=1,4),M=7,8),
     & (PARAM1(L),L=7,8)
      RETURN
C
1800  IF (NUM(I).EQ.1) GO TO 1810
      IF (RATED(I).EQ.1) GO TO 1820
      IF (YN(I).EQ.1) GO TO 1830
      RETURN
1810  WRITE (ITYOUT,22) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM(II,ML),ML=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM(II,ML),ML=4,6),((SYSNAM(M,MM),MM=1,4),M=7,9),
     & (PARAM(II,ML),ML=7,9)
      RETURN
1820  WRITE (ITYOUT,23) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,3),
     & ((SYSNAM(M,MM),MM=1,4),M=4,6),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=4,6),
     & ((SYSNAM(M,MM),MM=1,4),M=7,9),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=7,9)
      RETURN
1830  DO 1831 L=1,NSYS
         IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
         IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
1831  CONTINUE
      WRITE (ITYOUT,24) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM1(L),L=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM1(L),L=4,6),((SYSNAM(M,MM),MM=1,4),M=7,9),
     & (PARAM1(L),L=7,9)
      RETURN
C
1900  IF (NUM(I).EQ.1) GO TO 1910
      IF (RATED(I).EQ.1) GO TO 1920
      IF (YN(I).EQ.1) GO TO 1930
      RETURN
1910  WRITE (ITYOUT,25) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM(II,ML),ML=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM(II,ML),ML=4,6),((SYSNAM(M,MM),MM=1,4),M=7,9),
     & (PARAM(II,ML),ML=7,9),(SYSNAM(10,MM),MM=1,4),
     & PARAM(II,10)
      RETURN
1920  WRITE (ITYOUT,26) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=1,3),
     & ((SYSNAM(M,MM),MM=1,4),M=4,6),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=4,6),
     & ((SYSNAM(M,MM),MM=1,4),M=7,9),
     & ((IQUALT(IPARAM(ML),J),J=1,3),ML=7,9),
     & (SYSNAM(10,MM),MM=1,4),(IQUALT(IPARAM(10),J),J=1,3)
      RETURN
1930  DO 1931 L=1,NSYS
      IF (PARAM(II,L).EQ.0) PARAM1(L)=INO
      IF (PARAM(II,L).EQ.1) PARAM1(L)=IYES
1931  CONTINUE
      WRITE (ITYOUT,27) ((SYSNAM(M,MM),MM=1,4),M=1,3),
     & (PARAM1(L),L=1,3),((SYSNAM(M,MM),MM=1,4),M=4,6),
     & (PARAM1(L),L=4,6),((SYSNAM(M,MM),MM=1,4),M=7,9),
     & (PARAM1(L),L=7,9),(SYSNAM(10,MM),MM=1,4),
     & PARAM1(10)
      RETURN
C
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT (1X,1H*,2(12X,4A4),12X,1H*/,1X,1H*,2(12X,F16.3),12X,1H*)
2     FORMAT (1X,1H*,2(12X,4A4),12X,1H*/,1X,1H*,14X,3A4,16X,3A4,
      & 14X,1H*)
3      FORMAT (1X,1H*,2(12X,4A4),12X,1H*/,1X,1H*,18X,A3,25X,A3,19X,1H*)
4      FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,1H*)
5      FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),3A4,7X,1H*)
6      FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,12X,1H*)
7      FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,1H*/,
      & 1X,1H*,68X,1H*/,1X,1H*,26X,4A4,26X,1H*/,1X,1H*,26X,F16.3,26X,1H*)
8      FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),3A4,7X,1H*/,
      & 1X,1H*,68X,1H*/,1X,1H*,26X,4A4,26X,1H*/,1X,1H*,28X,3A4,28X,1H*)
9      FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,12X,1H*,
      & /,1X,1H*,68X,1H*/,1X,1H*,26X,4A4,26X,1H*/,1X,1H*,
      & 26X,4A4,26X,1H*/,1X,1H*,32X,A3,33X,1H*)
10     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,1H*/,1X,
      & 1H*,68X,1H*/,1X,1H*,2(12X,4A4),12X,1H*/,1X,1H*,2(12X,F16.3),
      & 12X,1H*)
11     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),3A4,7X,1H*/,
      & 1X,1H*,68X,1H*/,1X,1H*,2(12X,4A4),12X,1H*/,1X,1H*,14X,3A4,16X,
      & 3A4,14X,1H*)
12     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,12X,1H*,
      & /,1X,1H*,68X,1H*/,1X,1H*,2(12X,4A4),12X,1H*/,1X,1H*,18X,
      & A3,25X,A3,19X,1H*)
13     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,1H*/,1X,
      & 1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),
      & 5X,1H*)
14     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),3A4,7X,1H*/,
      & 1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),
      & 3A4,7X,1H*)
15     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,12X,1H*/,
      & 1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),
      & A3,12X,1H*)
16     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,1H*/,1X,
      & 1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,
      & 1H*/,1X,1H*,68X,1H*/,1X,1H*,26X,4A4,26X,1H*/,1X,1H*,26X,
      & F16.3,26X,1H*)
17     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),3A4,
      & 7X,1H*/,1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,
      & 7X,2(3A4,9X),3A4,7X,1H*/,1X,1H*,68X,1H*/,1X,1H*,26X,4A4,
      & 26X,1H*/,1X,1H*,28X,3A4,28X,1H*)
18     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,12X,1H*/,
      & 1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),
      & A3,12X,1H*/,1X,1H*,68X,1H*/,1X,1H*,26X,4A4,26X,1H*/,1X,1H*,
      & 32X,A3,33X,1H*)
19     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,1H*/,1X,
      & 1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),
      & 5X,1H*/,1X,1H*,68X,1H*/,1X,1H*,2(12X,4A4),12X,1H*/,1X,1H*,
      & 2(12X,F16.3),12X,1H*)
20     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),3A4,7X,1H*/,
      & 1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),
      & 3A4,7X,1H*/,1X,1H*,68X,1H*/,1X,1H*,2(12X,4A4),12X,1H*/,1X,
      & 1H*,14X,3A4,16X,3A4,14X,1H*)
21     FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,12X,1H*/,
      & 1X,1H*,68X,1H*/,1X,1H*,3(5Y,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,
      & 12X,1H*/,1X,1H*,68X,1H*/,1X,1H*,2(12X,4A4),12X,1H*/,1X,1H*,
      & 18X,A3,25X,A3,19X,1H*)
```

```
22    FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,1H*/,1X,
     & 1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,
     & 1H*/,1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,
     & 3(5X,F16.3),5X,1H*)
23    FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),3A4,7X,1H*/,
     & 1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),
     & 3A4,7X,1H*/,1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,
     & 7X,2(3A4,9X),3A4,7X,1H*)
24    FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,12X,1H*/,
     & 1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),
     & A3,12X,1H*/,1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,
     & 11X,2(A3,18X),A3,12X,1H*)
25    FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,1H*/,1X,
     & 1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,3(5X,F16.3),5X,
     & 1H*/,1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,
     & 3(5X,F16.3),5X,1H*/,1X,1H*,68X,1H*/,1X,1H*,26X,4A4,26X,1H*/,
     & 1X,1H*,26X,F16.3,26X,1H*)
26    FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),3A4,7X,1H*/,
     & 1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,7X,2(3A4,9X),
     & 3A4,7X,1H*/,1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,
     & 7X,2(3A4,9X),3A4,7X,1H*/,1X,1H*,68X,1H*/,1X,1H*,26X,4A4,26X,
     & 1H*/,1X,1H*,28X,3A4,28X,1H*)
27    FORMAT (1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),A3,12X,1H*/,
     & 1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,11X,2(A3,18X),
     & A3,12X,1H*/,1X,1H*,68X,1H*/,1X,1H*,3(5X,4A4),5X,1H*/,1X,1H*,
     & 11X,2(A3,18X),A3,12X,1H*/,1X,1H*,68X,1H*/,1X,1H*,26X,4A4,
     & 26Y,1H*/,1X,1H*,32X,A3,33X,1H*)
      END
C ******************************************************************
C ******************************************************************
C
      SUBROUTINE PAGER (LINE,LIMIT)
C      TEKTRONIX PAGING. REMOVE IF NOT USING A TEKTRONIX TERMINAL.
C
      IF (LINE+LIMIT.LT.34) RETURN
      LINE=0
      PAUSE  "TYPE GO FOR NEXT PAGE"
      RETURN
      END
      PROGRAM UPPP (INPUT,OUTPUT,HDR,DUM1,DUM2,UPP,TAPE10=HDR,
     & TAPE12=UPP,TAPE2=OUTPUT,TAPE5=INPUT,TAPE13=DUM1,TAPE14=DUM2)
C*****************************************************************
C**                                                              **
C*             USER'S PREFERENCE PACKAGE PROGRAM                 *
C* THIS PROGRAM CREATES THE USER'S PREFERENCE PACKAGE FOR SSMP   *
C**                                                              **
C*****************************************************************
C
      COMMON /UNITNO/ITTYIN,ITYOUT,IHDR,IUPP,IDUM1,IDUM2
      COMMON /HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),SYSNAM(10,4),
     & SUB1NM(10,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40), RATED(40),YN(40),INVERT(40),INDEX
      COMMON /RTNG/ RATING(50,40)
      COMMON /HDR2/ NSCEN,SCNDSC(25,15)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,SCNDSC,RATED,YN
C
C
      DATA IEND/3HEND/,ICRTE/4HCRTE/,IADD/3HADD/,ILIST/4HLIST/
C
      NPAGE=0
      LINE=34
      CALL PAGER(LINE,NPAGE,0)
      REWIND IUPP
      REWIND IHDR
      REWIND IDUM1
      REWIND IDUM2
      ITERN=0
C *** PRINT OUT HEADING ***
      WRITE(ITYOUT,4)
C *** PRINT OUT NOTE ON COMMANDS ***
      WRITE (ITYOUT,1)
C *** READ IN /HDR1/ ***
      CALL READR1
C *** ASK FOR COMMAND ***
      WRITE (ITYOUT,2)
      READ (ITTYIN,3) IANSR
100   IF (IANSR.EQ.IEND) GO TO 1000
      IF (IANSR.EQ.ICRTE) CALL CREATE
C *** READ IN /HDR2/ ***
      IF(IANSR.NE.ICRTE.AND.ITERN.EQ.0)CALL READR2
      IF (IANSR.EQ.IADD) CALL ADD
      IF (IANSR.EQ.ILIST) CALL LIST
      WRITE (ITYOUT,2)
      READ (ITTYIN,3) IANSR
      ITERN=1
      GO TO 100
C
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT (1X,48HNOTE: THE COMMANDS CRTE & ADD CAN BE ISSUED ONLY,
     & 12H ONCE DURING/1X,35HA SESSION & YOU CANNOT ISSUE A LIST,
     & 28H BEFORE YOU CREATE THAT FILE//)
C
2     FORMAT (1X,10HCOMMAND-->)
3     FORMAT (A4)
4     FORMAT(1H1,72(1H*),/1X,19X,33HUSER'S PREFERENCE PACKAGE PROGRAM,
     & /,1X,72(1H*)//)
C
C
1000  CONTINUE
      STOP
      END
C
C*********************************************************
C
      BLOCK DATA
C            -INITIALIZES UNIT NUMBERS FOR I/O
C
C*********************************************************
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDR,IUPP,IDUM1,IDUM2
      DATA ITTYIN,ITYOUT,IHDR,IUPP,IDUM1,IDUM2/5,2,10,12,13,14/
      END
C
C*********************************************************
      SUBROUTINE READR1
C            -THIS MODULE READS IN THE HEADER FILE AND FILLS THE
C             COMMON BLOCKS /HDR1/ AND /DB/
C
C*********************************************************
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDR,IUPP,IDUM1,IDUM2
      COMMON /HDR1/ SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(4),
     & SB1SET(4),SB2SET(4),SYSNAM(10,4),SUB1NM(10,4),
     & SUB2NM(10,10,4),PARNAM(40,4),NUM(40),RATED(40),YN(40),
     & INVERT(40),INDEX
      COMMON/DB/DBNAME(4)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,DBNAME
C
      REWIND IHDR
C
      READ(IHDR,3)(DBNAME(M),M=1,4)
      READ (IHDR,1) SYSDSN
      READ (IHDR,2) NSYS
      READ (IHDR,2) NSUB1
      READ (IHDR,2) NSUB2
      READ (IHDR,2) NPARM
      READ (IHDR,3) (SYSSET(I),I=1,4)
      IF (SYSDSN.GE.2) READ (IHDR,3) (SB1SET(I),I=1,4)
      IF (SYSDSN.EQ.3) READ (IHDR,3) (SB2SET(I),I=1,4)
C
      DO 100 I=1,NSYS
         READ (IHDR,3) (SYSNAM(I,J),J=1,4)
100   CONTINUE
```

```
C
      IF (NSUB1.EQ.0) GO TO 400
C
      DO 200 I=1,NSUB1
         READ (IHDR,3) (SUB1NM(I,J),J=1,4)
200   CONTINUE
C
      IF (NSUB2.EQ.0) GO TO 400
C
      DO 300 K=1,NSUB1
         DO 301 I=1,NSUB2
            READ (IHDR,3) (SUB2NM(K,I,J),J=1,4)
 301     CONTINUE
300   CONTINUE
C
400   CONTINUE
C
      DO 500 I=1,NPARM
         READ (IHDR,4) (PARNAM(I,J),J=1,4),NUM(I),RATED(I),YN(I),
     & INVERT(I)
C
500   CONTINUE
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT (I1)
2     FORMAT (I2)
3     FORMAT (4A4)
4     FORMAT (4A4,I1,I1,I1,I1)
C
      RETURN
      END
C
C
C***************************************************************
      SUBROUTINE CREATE
C            -THIS MODULE ALLOWS THE USER TO INPUT THE SCENARIO
C             DESCRIPTIONS AND NUMBER OF SCENARIOS AND TO WRITE
C             OUT THE NEW HEADER FILE,  THEN INPUT RATING VALUES.
C
C***************************************************************
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDR,IUPP,IDUM1,IDUM2
      COMMON /HDR1/   SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(4),
     & SB1SET(4),SB2SET(4),SYSNAM(10,4),SUB1NM(10,4),SUB2NM(10,10,4),
     & PARNAM(40,4),NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON /HDR2/ NSCEN,SCNDSC(25,15)
      COMMON /RTNG/ RATING(50,40)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,SCNDSC
C
C*** NO. OF SCENARIOS ***
      WRITE (ITYOUT,1)
      READ (ITTYIN,*) NSCEN
```

```
C*** SCENARIO DESCRIPTIONS ***
      DO 100 I=1,NSCEN
         WRITE (ITYOUT,3) I
         READ (ITTYIN,4) (SCNDSC(I,M),M=1,15)
100   CONTINUE
C
C*** WRITE OUT /HDR1/ ON TO NEW FILE
      CALL WRTR
C*** PERFORM PAIRED COMPARISON ***
      CALL COMPAR(1)
C
C *** FORMAT STATEMENTS ***
1     FORMAT (1X,22HENTER NO. OF SCENARIOS/)
3     FORMAT (1X,43HENTER SCENARIO DESCRIPTION FOR SCENARIO NO.,I2/)
4     FORMAT (15A4)
      RETURN
      END
C
C
C*************************************************************
C
      SUBROUTINE WRTR
C          -THIS MODULE WRITES OUT THE NEW HEADER FILE WITH THE
C           NEW SCENARIO INFORMATION.
C*************************************************************
C
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDR,IUPP,IDUM1,IDUM2
      COMMON /HDR1/ SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),SYSNAM(10,4),
     & SUB1NM(10,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/HDR2/NSCEN,SCNDSC(25,15)
      COMMON/DB/DBNAME(4)
C
      INTEGER SCNDSC,DBNAME
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,
     & SUB1NM,SUB2NM,PARNAM,RATED,YN
C
      REWIND IDUM1
C
      WRITE(IDUM1,3)(DBNAME(M),M=1,4)
C *** CASE I,II, OR III ***
      WRITE (IDUM1,1) SYSDSN
C *** NUMBER OF SYSTEMS ***
      WRITE (IDUM1,2) NSYS
C *** NUMBER OF LEVEL I SUBSYSTEMS ***
      WRITE (IDUM1,2) NSUB1
C *** NUMBER OF LEVEL 2 SUBSYSTEMS ***
      WRITE (IDUM1,2) NSUB2
C *** NUMBER OF PARAMETERS ***
      WRITE (IDUM1,2) NPARM
C *** SYSTEM SETNAMES ***
```

```
      WRITE (IDUM1,3) (SYSSET(I),I=1,4)
      IF (SYSDSN.GE.2) WRITE (IDUM1,3) (SB1SET(I),I=1,4)
      IF (SYSDSN.EQ.3) WRITE (IDUM1,3) (SB2SET(I),I=1,4)
C
C *** SYSTEM NAMES ***
      DO 100 I=1,NSYS
      WRITE(IDUM1,3)(SYSNAM(I,J),J=1,4)
100   CONTINUE
C
      IF(NSUB1.EQ.0)GO TO 400
C
C *** LEVEL 1 SUBSYSTEM NAMES ***
      DO 200 I=1,NSUB1
        WRITE(IDUM1,3)(SUB1NM(I,J),J=1,4)
200   CONTINUE
C
      IF (NSUB2.EQ.0) GO TO 400
C
C *** LEVEL 2 SUBSYSTEM NAMES ***
      DO 300 K=1,NSUB1
         DO 301 L=1,NSUB2
           WRITE(IDUM1,3)(SUB2NM(K,L,J),J=1,4)
301      CONTINUE
300   CONTINUE
C
400   CONTINUE
C
C *** PARAMETER NAMES ***
      DO 500 I=1,NPARM
         WRITE (IDUM1,4) (PARNAM(I,J),J=1,4),NUM(I),RATED(I),YN(I),
     & INVERT(I)
500   CONTINUE
C
C *** NUMBER OF SCENARIOS ***
      WRITE(IDUM1,2)NSCEN
C
C *** SCENARIO DESCRIPTIONS ***
      DO 600 I=1,NSCEN
          WRITE(IDUM1,5)(SCNDSC(I,M),M=1,15)
600   CONTINUE
C*** FORMAT STATEMENTS ***
C
1     FORMAT (I1)
2     FORMAT (I2)
3     FORMAT (4A4)
4     FORMAT (4A4,I1,I1,I1,I1)
5     FORMAT(15A4)
C
      RETURN
      END
C
C
C***************************************************************
C
```

```
      SUBROUTINE COMPAR
C           -THIS MODULE ALLOWS THE USER TO INPUT THE PARAMETER
C            RATINGS AND/OR PERFORM THE PAIRED COMPARISON ANALYSIS
C
C************************************************************
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDP,IUPP,IDUM1,IDUM2
      COMMON /HDR1/ SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),SYSNAM(10,4),
     & SUB1NM(10,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON /HDR2/ NSCEN,SCNDSC(25,15)
      COMMON /RTNG/ RATING(50,40)
C
      DIMENSION ICOUNT(40),IORDER(40)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,SCNDSC
C
C
      DATA ICHARA/1HA/,ICHARB/1HB/
      DATA IYES/3HYES/
C
C  USER GIVEN CHOICE OF ENTERING RATINGS IMMEDIATELY
C  OR PERFORMING THE COMPARISON ANALYSIS
      WRITE (ITYOUT,8)
      READ(ITTYIN,9)IANSR
      NPAGE=0
      LINE=34
      CALL PAGER(LINE,NPAGE,0)
      IF(IANSR.EQ.IYES)GO TO 500
      DO 100 J=1,NSCEN
        DO 110 KK=1,NPARM
          ICOUNT(KK)=0
110   CONTINUE
C
C *** PRINT OUT SCENARIO DESCRIPTIONS ***
          WRITE (ITYOUT,1) (SCNDSC(J,M),M=1,15)
          LINE=2
          DO 200 I=1,NPARM
              DO 210 I1=1,NPARM
                  IF (I1.LE.I) GO TO 210
C *** PRINT OUT PARAMETER NAMES ***
                  NPAGE=0
                  CALL PAGER(LINE,NPAGE,3)
                  WRITE (ITYOUT,2) ICHARA,(PARNAM(I,M),M=1,4),ICHARB,
     &             (PARNAM(I1,M1),M1=1,4)
                  READ (ITTYIN,3) ICHAR
                 LINE=LINE+2
C *** ADD UP THE NUMBER OF TIMES CHOSEN ***
                  IF (ICHAR.EQ.ICHARA) ICOUNT(I)=ICOUNT(I)+1
                  IF (ICHAR.EQ.ICHARB) ICOUNT(I1)=ICOUNT(I1)+1
210             CONTINUE
200         CONTINUE
C
```

```
C ORDER THE PARAMETERS BASED ON THE NUMBER OF TIMES
C CHOSEN (HIGH TO LOW)
         CALL LARGE (NPARM,ICOUNT,IORDER)
         WRITE (ITYOUT,4)
C PRINT OUT PARAMETERS IN ORDER WITH THE NUMBER OF TIMES CHOSEN
C AND READ IN RATINGS
         DO 300 I=1,NPARM
            K=IORDER(I)
            WRITE (ITYOUT,5) (PARNAM(K,M),M=1,4),ICOUNT(K)
            READ (ITTYIN,6) RATING (J,K)
300      CONTINUE
C
100   CONTINUE
C
C *** WRITE OUT UPP DATA FILE ***
      DO 400 K=1,NSCEN
        DO 400 I=1,NPARM
         WRITE(IDUM2,7)RATING(K,I)
400   CONTINUE
      REWIND IDUM2
      RETURN
500   DO 600 J=1,NSCEN
      WRITE(ITYOUT,1)(SCNDSC(J,M),M=1,15)
        DO 700 I=1,NPARM
        WRITE(ITYOUT,10)(PARNAM(I,M),M=1,4)
        READ(ITTYIN,6)RATING(J,I)
700   CONTINUE
      NPAGE=0
      LINE=34
      CALL PAGER(LINE,NPAGE,0)
600   CONTINUE
        DO 800 K=1,NSCEN
        DO 800 I=1,NPARM
            WRITE(IDUM2,7)RATING(K,I)
800   CONTINUE
      REWIND IDUM2
      RETURN
C
C*** FORMAT STATEMENTS ***
C
1     FORMAT (10X,15A4)
2     FORMAT (1X,1X,A1,4H -- ,4A4,3H / ,A1,4H -- ,4A4,/)
3     FORMAT (A1)
4     FORMAT (1X,//,1X,43HRATE THE PARAMETERS WITH VALUES FROM 0 TO 1,/)
5     FORMAT (1X,/1X,4A4,9H (CHOSEN ,I2,7H TIMES),/)
6     FORMAT (F5.3)
7     FORMAT (1X,F5.3)
8     FORMAT(1X,52HDO YOU WISH TO SKIP THE PAIRED COMPARSION ? (YES/NO),
     & /)
9     FORMAT(A3)
10    FORMAT(1X,4A4,/)
C
      END
C
```

```
C
C*****************************************************************
C
      SUBROUTINE ADD
C           -THIS ROUTINE ALLOWS THE USER TO ADD SCENARIOS
C
C*****************************************************************
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHSP,IUPP,IDUM1,IDUM2
      COMMON /HDR1/ SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),SYSNAM(10,4),
     & SUB1NM(10,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON /HDR2/ NSCEN,SCNDSC(25,15)
      COMMON /RTNG/ RATING(50,40)
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,SCNDSC
C
C*** NO. OF SCENARIOS ADDING ***
C
      WRITE (ITYOUT,1)
      READ (ITTYIN,*) ISCEN
      K=ISCEN
      NOLD=NSCEN + 1
C *** READ IN NEW SCENARIO DESCRIPTION ***
      DO 100 I=1,K
      L=I + NSCEN
         WRITE (ITYOUT,3) L
         READ(ITTYIN,4)  (SCNDSC(L,M),M=1,15)
100   CONTINUE
C
      NSCEN=ISCEN + NSCEN
C *** WRITE OUT HEADER FILE ***
      CALL WRTR
C *** ENABLE USER TO ENTER PARAMETER RATINGS ***
      CALL COMPAR(NOLD)
C
C*** FORMAT STATEMENTS ***
C
1     FORMAT (1X,39HHOW MANY SCENARIOS DO YOU WISH TO ADD ?/)
2     FORMAT (I2)
3     FORMAT (1X,43HENTER SCENARIO DESCRIPTION FOR SCENARIO NO.,I2,/)
4     FORMAT (15A4)
C
      RETURN
      END
C
C
C*****************************************************************
      SUBROUTINE LARGE (NPARM,ICOUNT,IORDER)
C           - THIS ROUTINE FINDS THE LARGEST NUMBER OF TIMES A
C             PARAMETER WAS CHOSEN DURING THE PAIRED COMPARISION.
C
```

```
C*****************************************************************
C
      DIMENSION ICOUNT(40),ICNT(40),IORDER(40)
C
C *** TRANSFER NUMBERS TO NEW ARRAY ***
      DO 100 I=1,NPARM
         ICNT(I)=ICOUNT(I)
100   CONTINUE
C
      DO 200 K=1,NPARM
         BIG=-1
         INDICE=0
C *** CHECK FOR LARGEST VALUE ***
         DO 300 I=1,NPARM
            IF (ICNT(I).GT.BIG) GO TO 305
            GO TO 300
305         BIG=ICNT(I)
            INDICE=I
300      CONTINUE
         IF (INDICE.EQ.0) INDICE=K
C ONCE LARGEST VALUE FOUND, MAKE -1 SO NEXT HIGHEST IS FOUND
         ICNT(INDICE)=-1
C KEEP TRACK OF ORDER (HIGH TO LOW) OF PARAMETERS
         IORDER(K)=INDICE
200   CONTINUE
C
      RETURN
      END
C
C
C*********************************************************************
C
      SUBROUTINE LIST
C          -THIS ROUTINE ALLOWS THE USER TO PRINT THE PARAMETER
C           RATINGS FOR EACH SCENARIO PLUS THE AVERAGE RATING
C           FOR EACH PARAMETER.
C
C*****************************************************************
C
      COMMON /UNITNO/ ITTYIN,ITYOUT,IHDP,IUPP,IDUM1,IDUM2
      COMMON /HDR1/ SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),SYSNAM(10,4),
     & SUB1NM(10,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON /HDR2/ NSCEN,SCNDSC(25,15)
      COMMON /RTNG/ RATING(50,40)
      COMMON/C2/DPNAME(4)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,SCNDSC,DPNAME
      DIMENSION SUM(50),AVE(50),PSUM(40),PAVE(40),IAVENM(15)
      DATA SUM/50*0/,AVE/50*0/,PAVE/40*0/,PSUM/40*0/
      DATA IAVENM/4H    ,4H    ,4H  AV,4HERAG,4HE VA,4HLUES,4H FOR,
     & 4H EAC,4HH PA,4HRAME,4HTER ,4H    ,4H    ,4H    ,4H    /
C
```

```
C *** SUM UP RATINGS FOR AVERAGE ***
      DO 200 I=1,NSCEN
        DO 250 J=1,NPARM
          SUM(I)=SUM(I) + RATING(I,J)
250   CONTINUE
        AVE(I)=SUM(I)/NPARM
200   CONTINUE
C *** AVERAGE PARAMETER RATING ***
C
      DO 300 J=1,NPARM
        PSUM(J)=0
        DO 350 I=1,NSCEN
          PSUM(J) = PSUM(J) + RATING(I,J)
350   CONTINUE
      RSCEN=NSCEN
      PAVE(J)=PSUM(J)/RSCEN
300   CONTINUE
C *** WRITE HEADING ***
C
      DO 100 I=1,NSCEN
      NPAGE=1
         WRITE(ITYOUT,1)(DBNAME(L99),L99=1,4),SYSDSN,
     & (SCNDSC(I,M),M=1,15),I
C *** WRITE PARAMETER NAME AND RATING ***
         DO 150 J=1,NPARM
           WRITE(ITYOUT,2)(PARNAM(J,M),M=1,4),RATING(I,J)
150      CONTINUE
      LINE=34
      CALL PAGER(LINE,NPAGE,0)
100   CONTINUE
C *** WRITE HEADING FOR AVERAGE PARAMETER RATINGS ***
      N = NSCEN + 1
      WRITE(ITYOUT,1)(DBNAME(L99),L99=1,4),SYSDSN,(IAVENM(MM),MM=1,15),
     & N
C *** WRITE PARAMETER NAMES AND AVERAGE RATINGS ***
        DO 400 J=1,NPARM
          WRITE(ITYOUT,2)(PARNAM(J,M),M=1,4),PAVE(J)
400   CONTINUE
      NPAGE=0
      LINE=34
      CALL PAGER(LINE,NPAGE,0)
C
C*** FORMAT STATEMENTS ***
C
1     FORMAT(1H ,/,1X,72(1H*),1X,5X,4A4,5X,5HCASE ,I1,3X,
     & 25HUSER'S PREFERENCE PACKAGE,/,1X,15A4,5X,5HPAGE ,
     & I2,/,1X,72(1H*))
2      FORMAT (1X,/,1X,20X,4A4,5X,F5.3)
3      FORMAT(1X,/,1X,20X,16(1H-),5X,5(1H-),//,1X,20X,
     & 13HAVERAGE VALUE,6X,F5.3)
C
       RETURN
       END
C
```

```
C*****************************************************************
C
      SUBROUTINE READR2
C           - THIS ROUTINE IS USED WHEN THE USER WISHES TO
C            ADD MORE SCENARIOS
C***********************************************************
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,IUPP,IDUM1,IDUM2
      COMMON/HDR2/NSCEN,SCNDSC(25,15)
      COMMON/RTNG/RATING(50,40)
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),SYSNAM(10,4),
     & SUB1NM(10,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
C
      INTEGER SCNDSC
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,RATED,YN
C *** READ NUMBER OF SCENARIOS ***
      READ(IHDR,1)NSCEN
C *** READ SCENARIO DESCRIPTIONS ***
      DO 100 I=1,NSCEN
        READ(IHDR,2)(SCNDSC(I,M),M=1,15)
100   CONTINUE
C *** READ RATINGS ***
      DO 200 I=1,NSCEN
        DO 200 J=1,NPARM
         READ(IUPP,3)RATING(I,J)
200   CONTINUE
C
C
C *** FORMAT STATEMENTS ****
C
1     FORMAT(I2)
2     FORMAT(15A4)
3     FORMAT(F5.3)
C
      RETURN
      END
C
C *****************************************************************
C *****************************************************************
C
      SUBROUTINE PAGER(LINE,NPAGE,LIMIT)
      IF((LINE+LIMIT).LT.34)RETURN
      PAUSE"TYPE GO FOR NEXT PAGE"
      LINE=0
      NPAGE=NPAGE+1
      RETURN
      END
      OVEPLAY(SSM,0,0)
      PROGRAM SSM(INPUT=512,OUTPUT=512,HEADER=512,PP=512,UPP=512,
     & VPARM=512,SYSNUM,TAPE5=INPUT,TAPE2=OUTPUT,TAPE10=HEADEP,
     & TAPE12=PP,TAPE13=UPP,TAPE14=VPARM,TAPE15=SYSNUM)
C
C ***************************************************************
C
C                          MAIN OVERLAY
C
C     DIRECTS THE EXECUTION OF THE OTHEP LEVELS OF OVERLAYS &
C     SUBROUTINES
C
C ***************************************************************
C
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     &              SYSSET(4),SB1SET(4),SB2SET(4),
     &              SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),
     &              PARNAM(40,4),
     &              NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      COMMON/PARAM1/NOPPM,CHPRM(40),ABV(40),BELW(40),
     & RLOWR(40),HIR(40),RTD(40),IRANGE(40),ISWNO(40)
      COMMON/PARAM3/MATPIX(40,7,10)
      COMMON/PARAM2/ELIM(7,10,40)
      COMMON/RTNG/RATING(40)
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON/RTG/PTING(40)
      COMMON/DB/DBNAME(4)
      INTEGER SCNDSC
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,PAPNAM,
     & PATED,YN,ELIM,MATRIX,CHPRM,DBNAME
C
100   REWIND IPP
      REWIND IPPH
      REWIND IUPP
      REWIND IUPPH
C
C *** READ IN FILE WITH HEADER IN IT FOR PARAMETER PACKAGE
C
      CALL OVERLAY(3HSSM,1,0,0)
C
C
C *** USEP CHOOSES SCENERIO OR INPUTS HIS OWN RATINGS
C
      CALL OVERLAY(3HSSM,2,0,0)
C
C *** PRINT OUT RATINGS TABLE ***
C
      CALL PATOUT
C
C *** CHOOSE THE PARAMETERS WANTED IN THE DECISION PROCESS
C
      CALL OVERLAY(3HSSM,3,0,0)
```

```
C
C *** ELIMINATE SYSTEMS THAT DO NOT QUALIFY OR ARE NOT WANTED
C
      CALL OVERLAY(3HSSM,4,0,0)
C
C *** INVERTS DATA SO THAT THE LOWEST VALUES CONSTITUTE THE BEST
C     VALUE
C
      CALL OVERLAY(3HSSM,5,0,0)
C
C *** CALCULATE SYSTEM VALUES & DETERMINE THE OPTIMUM SYSTEM
C
      CALL OVERLAY(3HSSM,6,0,0)
C
C *** DETERMINE SENSITIVITY & UNCERTAINITY ANALYSIS
C
      CALL ANLYS(IEXEC)
      IF(IEXEC.EQ.1)GO TO 100
      STOP
      END
C *****************************************************************
C *****************************************************************
C
      SUBROUTINE ANLYS(IEXEC)
C
C *****************************************************************
C
C     THIS ROUTINE ALLOWS THE USER TO ADD ANY LOGIC NEEDED TO ANALYZE
C     THE DECISION & TO ALLOW THE USER TO RERUN THE MODEL
C
C *****************************************************************
C
      COMMON/RTG/RTING(40)
      COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),
     & SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,RATED,YN,SCNDSC
      DATA INO/2HNO/
C
      IEXEC=0
      WRITE(ITYOUT,1)
      READ(ITTYIN,2)IANSR
      IF(IANSR.EQ.INO)GO TO 9000
      IEXEC=1
9000  RETURN
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT(1X,//,1X,26HDO YOU WISH TO EXECUTE THE,
     & 25H PROGRAM AGAIN ? (YES/NO)/)
```

```
2     FORMAT(A3)
      END
C
C ***********************************************************
C ************************************************************
C
      SUBROUTINE RATOUT
C
C ************************************************************
C
C     THIS ROUTINE PRINTS THE RATINGS CHOSEN IN A TABLE
C
C *************************************************************
C
      COMMON/RTG/RTING(40)
      COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),
     & SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,RATED,YN,SCNDSC
C
C     TEKTRONIX PAGING:  TAKE OUT IF NOT USING TEKTRONIX TERMINAL OR
C     GRAPHICS
      LINE=34
      NPAGE=0
      CALL PAGER(LINE,NPAGE,0)
      WRITE(ITYOUT,1)(SCNDSC(ICHOIC,M),M=1,15)
C
      DO 100 I=1,NPARM
        WRITE(ITYOUT,2)(PARNAM(I,M),M=1,4),RTING(I)
100   CONTINUE
C
      WRITE(ITYOUT,3)
C
      RETURN
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT(1X,//,15X,15A4,//,21X,38(1H*),/21X,1H*,5X,
     & 13H   PARAMETERS,8X,1H*,10H RATINGS *,/,1X,20X,38(1H*))
2     FORMAT(21X,1H*,5X,4A4,5X,1H*,2X,F5.3,2X,1H*)
3     FORMAT(21X,38(1H*),//)
      END
C
C *************************************************************
C *************************************************************
C
      BLOCK DATA
C
C *************************************************************
C
```

```
C     ALLOWS THE USER TO CHANGE UNIT NUMBERS FOR I/O MORE EASILY
C
C ************************************************************
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      DATA ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS/5,2,10,10,12,
     & 13,14,15/
      END
C **********************************************************
C **********************************************************
C
      SUBROUTINE PAGER(LINE,NPAGE,LIMIT)
      IF((LINE+LIMIT).LT.34) RETURN
      PAUSE "TYPE GO FOR NEXT PAGE"
      LINE=0
      NPAGE=NPAGE+1
      RETURN
      END
C
C ************************************************************
C ************************************************************
C
      OVERLAY(SSM,1,0)
      PROGRAM RPP
C
C ************************************************************
C
C       THIS ROUTINE READS IN THE INFORMATION THAT DESCRIBES THE
C      PARAMETER PACKAGE AND PLACES IT IN COMMON STATEMENT /HDR1/
C
C ************************************************************
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     &               SYSSET(4),SB1SET(4),SB2SET(4),
     &               SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),
     &             PARNAM(40,4),
     &               NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      COMMON/DB/DBNAME(4)
      COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,RATED,YN,DBNAME,SCNDSC
C
C *** READ IN DATA BASE NAME FOR PARAMETER PACKAGE ***
C
      READ (IPPH,3)(DBNAME(M),M=1,4)
C
C *** READ IN SYSTEM DESIGN
C
      READ(IPPH,1)SYSDSN
C
C *** READ NO. OF SYSTEMS,SUBSYSTEMS,PARAMETER
C
      READ(IPPH,2)NSYS
      READ(IPPH,2)NSUB1
      READ(IPPH,2)NSUB2
      READ(IPPH,2)NPARM
      IF(NSYS.EQ.0)GO TO 600
C
C *** READ IN SETNAMES
C
      READ(IPPH,3)(SYSSET(I),I=1,4)
      IF(SYSDSN.GE.2)READ(IPPH,3)(SB1SET(I),I=1,4)
      IF(SYSDSN.EQ.3)READ(IPPH,3)(SB2SET(I),I=1,4)
C
C *** READ IN SYSTEM NAMES
C
      DO 100 I=1,NSYS
      READ(IPPH,3)(SYSNAM(I,J),J=1,4)
100   CONTINUE
      IF(NSUB1.EQ.0)GO TO 400
C
C *** READ IN SUBSYSTEM LEVEL 1 NAMES
C
      DO 200 I=1,NSUB1
        READ (IPPH,3)(SUB1NM(I,J),J=1,4)
200   CONTINUE
      IF(NSUB2.EQ.0)GO TO 400
C *** READ IN SUBSYSTEM LEVEL 2 NAMES
      DO 300 K=1,NSUB1
      DO 301 I=1,NSUB2
        READ (IPPH,3)(SUB2NM(K,I,J),J=1,4)
301   CONTINUE
300   CONTINUE
C
400   CONTINUE
C
C *** READ IN PARAMETER NAMES & PARAMETER CHARACTERISTICS
C
      DO 500 I=1,NPARM
        READ(IPPH,4)(PARNAM(I,J),J=1,4),NUM(I),RATED(I),YN(I),
     & INVEPT(I)
500   CONTINUE
C
      GO TO 700
C
600   WRITE(ITYOUT,5)
      CALL EXIT
C
C *** CALCULATE INDEX FOR POSITIONING FILES ***
C
700   CONTINUE
      IF(NSUB1.EQ.0)GO TO 800
      IF(NSUB2.EQ.0)GO TO 900
        INDEX=NSUB1*NSUB2
        GO TO 1000
800   INDEX=1
        GO TO 1000
900   INDEX=NSUB1
1000  CONTINUE
```

```
C
C *** CALL RUPP ***
C
      CALL OVERLAY(3HSSM,1,1,0)
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT(I1)
2     FORMAT(I2)
3     FORMAT(4A4)
4     FORMAT(4A4,I1,I1,I1,I1)
5     FORMAT(1X,37HERROR IN HEADER -- NO. OF SYSTEMS = 0)
C
      END
C
C ******************************************************
C ******************************************************
C
      OVERLAY(SSM,1,1)
      PROGRAM RUPP
C
C ******************************************************
C     THIS ROUTINE READS IN THE INFORMATION THAT DESCRIBES THE
C     USER PREFERENCE PACKAGE AND PLACES IT IN COMMON STATEMENT
C     /HDR2/
C ******************************************************
C
      COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      INTEGER SCNDSC
C
C *** READ IN NO. OF SCENERIOS
C
      READ(IUPPH,1)NSCEN
C
      IF(NSCEN.EQ.0)WRITE(ITYOUT,2)
C
C *** READ IN SCENERIO DESCRIPTION
C
      DO 100 I=1,NSCEN
         READ(IUPPH,3)(SCNDSC(I,J),J=1,15)
100   CONTINUE
C
C *** FORMAT STATFMENTS ***
C
1     FORMAT(I2)
2     FORMAT(49H ERROR IN USER PREFERENCE PACKAGE - NO. OF SCENAR,
     & 6HIOS =0)
3     FORMAT(15A4)
      END
C
C ******************************************************
C ******************************************************
C
```

```
      OVERLAY(SSM,2,0)
      PROGRAM SCNSEL
C
C ***************************************************************
C
C     THIS ROUTINE READS IN THE RATINGS ARRAY EITHER BY THE USER'S
C     PREFERENCE PACKAGE OR BY THE USER'S OWN RATINGS
C
C ***************************************************************
C
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     &          SYSSET(4),SB1SET(4),SB2SET(4),
     &          SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),
     &           PARNAM(40,4),
     &          NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      COMMON/RTNG/RATING(40)
      COMMON/RTG/RTING(40)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,PARNAM,
     & RATED,YN,SCNDSC
      DATA IYES/3HYES/
C
C *** WRITE OUT TITLE ***
C
C     TEKTRONIX PAGING:  TAKE OUT IF NOT USING TEKTRONIX TERMINAL OR
C     GRAPHICS
      LINE=34
      NPAGE=0
      CALL PAGER(LINE,NPAGE,0)
      WRITE(ITYOUT,15)
C
C *** WRITE OUT AVAILABLE PARAMETERS ***
C
      WRITE(ITYOUT,13)
      DO 199 I=1,NPARM
       WRITE(ITYOUT,14)I,(PARNAM(I,J),J=1,4)
199   CONTINUE
C
C *** INPUT OWN RATINGS ? ***
C
C     TEKTRONIX PAGING
      LINE=34
      NPAGE=0
      CALL PAGER(LINE,NPAGE,0)
      WRITE(ITYOUT,1)
      READ(ITTYIN,8)IANS
      IF(IANS.EQ.IYES)GO TO 100
      WRITE(ITYOUT,11)
C
C *** PRINT OUT SCENERIO DESCRIPTIONS ***
C
      DO 200 I=1,NSCEN
       WRITE(ITYOUT,10)I,(SCNDSC(I,J),J=1,15)
```

```
200   CONTINUE
C
C *** READ IN CHOICE OF SCENERIC
C
      WRITE(ITYOUT,9)
      READ(ITTYIN,*)ICHOIC
      IF(ICHOIC.EQ.0.OR.ICHOIC.GT.NSCEN)WRITE(ITYCUT,16)
      IF(ICHOIC.EQ.1)GO TO 250
      INDEX1=(ICHOIC-1)*NPARM
C
      GO TO 260
C
C *** READ IN RATINGS FROM USERS' PREFERENCE PACKAGE ***
C
250   DO 300 I=1,NPARM
        READ(IUPP,5)RATING(I)
300   CONTINUE
C
      GO TO 1000
C
260   DO 310 I=1,INDEX1
        READ (IUPP,6)IDUM
310   CONTINUE
C
      DO 400 I=1,NPARM
        READ(IUPP,5)RATING(I)
400   CONTINUE
C
      GO TO 1000
C
100   CONTINUE
C
C *** READ IN USER'S OWN RATINGS ***
C
C     TEKTRONIX PAGING
      NPAGE=0
      LINE=34
      ICHOIC=1
      WRITE(ITYOUT,2)
      READ(ITTYIN,3)(SCNDSC(1,J),J=1,15)
      CALL PAGER(LINE,NPAGE,0)
      WRITE(ITYOUT,17)
      DO 500 I=1,NPARM
        WRITE(ITYOUT,12)(PARNAM(I,J),J=1,4)
        READ(ITTYIN,*)RATING(I)
      IF(RATING(I).LT.0.OR.RATING(I).GT.1)WRITE(ITYOUT,16)
500   CONTINUE
C
1000  DO 1001 L=1,NPARM
      RTING(L)=RATING(L)
1001  CONTINUE
C
C *** FORMAT STATEMENTS ***
C
```

```
1      FORMAT(1X,/,1X,,40HDO YOU WISH TO ENTER YOUR OWN RATINGS ? ,
     & 8H(YES/NO)/)
2      FORMAT(1X,30HPLEASE ENTER YOUR SCENARIO DES,
     & 24HCRIPTION,LIMIT=60 CHARS./)
3      FORMAT(15A4)
4      FORMAT(I2)
5      FORMAT(1X,F5.3)
6      FORMAT(A1)
7      FORMAT(4A4)
8      FORMAT(A3)
9      FORMAT(1X,//,1X,30HENTER NO OF CHOICE OF SCENARIO,/)
10     FORMAT(6X,I2,4H -- ,15A4)
11     FORMAT(1X,//,1X,19HSCENARIOS AVAILABLE,/)
12     FORMAT(1X,4A4,/)
13     FORMAT(1X,29HLIST OF AVAILABLE PARAMETERS,//)
14     FORMAT(1X,I2,4H -- ,4A4)
15     FORMAT(1H1,/,1X,72(1H*),//,20X,30HSYSTEM SELECTION MODEL PROGRAM,
     & //,1X,72(1H*),//)
16     FORMAT(1X,//,1X,
     & 50H ***-ERROR-*** BAD INPUT--STOP EXECUTION & RESTART,/)
17     FORMAT(1X,//,1X,
     & 45HPLEASE ENTER RATINGS (0-1) FOR EACH PARAMETER,/)
       END
C
C *************************************************************
C *************************************************************
C
       OVERLAY(SSM,3,0)
       PROGRAM PARSEL
C
C ************************************************************
C
C      READS IN PARAMETERS WANTED AND THEIR RESPECTIVE RANGES THAT
C      ARE TO BE INCLUDED IN THE DECISION PROCESS
C
C ************************************************************
C
       COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     &            SYSSET(4),SB1SET(4),SB2SET(4),
     &            SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),
     &            PARNAM(40,4)
     &           ,NUM(40),RATED(40),YN(40),INVERT(40),INDEX
       COMMON/PARAM1/NOPRM,CHPRM(40),ABV(40),BELW(40),RLOWR(40),
     & HIR(40),RTD(40),IRANGE(40),ISWNO(40)
       COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
       INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & RATED,YN,PARNAM
       INTEGER CHPRM
       DATA INO/2HNO/
C
C *** INITIALIZE TO ZERO ***
C
       DO 199 KHY=1,40
       ABV(KHY)=0
```

```
      BELW(KHY)=0
      RLOWR(KHY)=0
      HIR(KHY)=0
      RTD(KHY)=0
      IRANGE(KHY)=0
      CHPPM(KHY)=0
      ISWNO(KHY)=0
199   CONTINUE
C
C *** NO. OF PARAMETERS CHOSEN ***
C
C     TEKTRONIX PAGING
      LINE=34
      NPAGE=0
      CALL PAGER(LINE,NPAGE,C)
      WRITE(ITYOUT,3)
      READ(ITTYIN,*)NOPRM
      IF(NOPRM.LE.0.OR.NOPRM.GT.NPARM)WRITE(ITYOUT,18)
      WRITE(ITYOUT,16)
C
C *** READ IN CHOICE OF PARAMETERS
      DO 200 I=1,NOPRM
        WRITE(ITYOUT,17)
        READ(ITTYIN,*)CHPRM(I)
      IF(CHPRM(I).LE.0.OR.CHPRM(I).GT.NPARM)WRITE(ITYOUT,18)
200   CONTINUE
C
C *** READ RANGES OR LIMITS ON INDIVIDUAL PARAMTERS,IF ANY
C
C     TEKTRONIX PAGING
      NPAGE=0
      LINE=34
      CALL PAGER(LINE,NPAGE,C)
      DO 300 I=1,NOPRM
        K=CHPRM(I)
      LINE=34
      NPAGE=0
      IF(I.EQ.5.OR.I.EQ.10.OR.I.EQ.15.OR.I.EQ.20.OR.I.EQ.25.OR.I.EQ.30.
     & .OR.I.EQ.35.OR.I.EQ.40)CALL PAGER(LINE,NPAGE,C)
        WRITE(ITYOUT,5)(PARNAM(K,J),J=1,4)
        IF(NUM(K).EQ.1)GO TO 1000
        IF(RATED(K).EQ.1) GO TO 2000
        IF(YN(K).EQ.1)WRITE(ITYOUT,15)
300   CONTINUE
C
      GO TO 9190
C
C *** SPECIFY A LIMIT ? ***
C
1000  WRITE(ITYOUT,6)
      READ(ITTYIN,7)IANS
      IF(IANS.EQ.INO)ISWNO(I)=1
      IF(IANS.EQ.INO)GO TO 300
C
```

```
C *** ABOVE,BELOW, OR IN BETWEEN ? ***
C
      WRITE(ITYOUT,8)
      READ(ITTYIN,9)IRNG
      IF(IRNG.LE.0.OR.IRNG.GT.3)WRITE(ITYOUT,18)
      IRANGE(I)=IRNG
C
      GO TO(10,20,30),IRNG
C
C *** ABOVE ***
C
10    WRITE(ITYOUT,11)(PARNAM(K,J),J=1,4)
      READ(ITTYIN,*)ABV(K)
      BELW(K)=0
      RLOWR(K)=0
      HIR(K)=0
      GO TO 1001
C
C *** BELOW ***
C
20    WRITE(ITYOUT,12)(PARNAM(K,J),J=1,4)
      READ(ITTYIN,*)BELW(K)
      ABV(K)=0
      RLOWR(K)=0
      HIR(K)=0
      GO TO 1001
C
C *** IN BETWEEN ****
C
30    WRITE(ITYOUT,12)(PARNAM(K,J),J=1,4)
      READ(ITTYIN,*)HIR(K)
      WRITE(ITYOUT,11)(PARNAM(K,J),J=1,4)
      READ(ITTYIN,*)RLOWR(K)
      ABV(K)=0
      BELW(K)=0
C
1001  GO TO 300
C
C *** SPECIFY LIMIT ? ***
C
2000  WRITE(ITYOUT,6)
      READ(ITTYIN,7)IANS
      IF(IANS.EQ.INO)ISWNO(I)=1
      IF(IANS.EQ.INO)GO TO 300
      WRITE(ITYOUT,14)
      READ(ITTYIN,9)IIANS
      IF(IIANS.LE.0.OR.IIANS.GT.5)WRITE(ITYOUT,18)
        RTD(K)=IIANS
      IRANGE(I)=IIANS
      GO TO 300
C
C *** FORMAT STATEMENTS ***
C
3     FORMAT(1X,45HENTER THE NUMBER OF PARAMETERS
```

AD-A119 160   SOUTHEASTERN CENTER FOR ELECTRICAL ENGINEERING EDUCAT--ETC   F/G 9/2
ADVANCED TECHNOLOGY MULTIPLE CRITERIA DECISION MODEL.(U)
NOV 81   P J SWEENEY, K B BERNER, J R FRAKER   F33615-77-C-2059
UNCLASSIFIED   AFWAL-TR-81-2112   NL

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     & 24H IN THE DECISION PROCESS/)
4      FORMAT(I2)
5      FORMAT(1X,/,1X,13HPARAMETER -- ,4A4)
6      FORMAT(53H WOULD YOU LIKE TO SPECIFY A LIMIT THAT THE PARAMETER/,
     & 26H HAS TO SATISFY ? (YES/NO)/)
7      FORMAT(A3)
8      FORMAT (1X,37HDO YOU WANT THE PARAMETER TO BE ABOVE,
     & 7H, BELOW,/,1X,34HOR IN BETWEEN THE SPECIFIED LIMIT?,/,
     & 1X,32H(CHOOSE 1, 2, OR 3 RESPECTIVELY),/)
9      FORMAT(I1)
11     FORMAT(1X,4A4,1H>)
12     FORMAT(1X,4A4,1H<)
14     FORMAT(1X,46HTHIS PARAMETER CAN BE RATED AS EXCELLENT,GOOD,,
     & 24HFAIR,POOR, OR VERY POOR,/1X,26HCHOOSE 1,2,3,4,OR,5,RESP.,/)
15     FORMAT(1X,47HA QUALATITIVE PARAMETER--CANNOT SPECIFY A RANGE)
16     FORMAT(1X,/1X,38HENTER EACH INTEGER NO. ASSOCIATED WITH,
     & 13H EACH CHOSEN ,/1X,34HPARAMETER (FROM LOWEST TO HIGHEST),/)
17     FORMAT(1X,18H PARAMETER NO. -- )
18     FORMAT(1X,//1X,50H ***-ERROR-BAD INPUT--STOP EXECUTION & RESTART,
     & /)
9190  CONTINUE
       END
C
C ****************************************************************
C ****************************************************************
C
       OVERLAY(SSM,4,0)
       PROGRAM ELIMIN
C
C ************************************************************
C      THIS ROUTINE ELIMINATES UNWANTED PARAMETERS AND RANGES
C      OF OTHER PARAMETERS
C ************************************************************
C
       COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),
     & SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
       COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
       COMMON/PARAM1/NOPRM,CHPRM(40),ABV(40),BELW(40),RLOWR(40),
     & HIR(40),RTD(40),IRANGE(40),ISWNO(40)
       COMMON/PARAM2/ELIM(7,10,40)
       COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
       COMMON/DB/DBNAME(4)
       DIMENSION PARAM(85,10)
       DIMENSION DUM(10)
       INTEGER MATRIX,ELIM,CHPRM
       INTEGER SYSDSN,SYSSET,SB2SET,SYSNAM,SUB1NM,SUB2NM,PARNAM,
     & RATED,YN,DBNAME,SCNDSC
C
C *** INITIALIZE MATRIX TO 1 ***
C
       DO 995 KMN2=1,NPARM
       DO 995 KMN=1,INDEX
```

```
      DO 995 KMN1=1,NSYS
        MATRIX(KMN2,KMN,KMN1)=1
995   CONTINUE
C
C *** INITIALIZE ELIM TO 0 ***
C
      DO 997 KJU=1,INDEX
      DO 997 KJU1=1,NSYS
      DO 997 KJU2=1,NPARM
        ELIM(KJU,KJU1,KJU2)=0
997   CONTINUE
      REWIND IUPP
      REWIND IPP
      K=0
C
C *** FIND PARAMETERS CHOSEN ***
C
      DO 200 I=1,NPARM
      DO 205 M=1,NOPRM
        IF(I.EQ.CHPRM(M))GO TO 210
205   CONTINUE
C
C *** INDEX FILE TO CORRECT PARAMETER ***
C
      DO 215 LJ=1,INDEX
      READ(IPP,*)(DUM(KLK),KLK=1,NSYS)
215   CONTINUE
C
C *** ELIMINATE PARAMETER ***
C
      DO 220 NL=1,INDEX
      DO 220 NLL=1,NSYS
        MATRIX(I,NL,NLL)=0
220   CONTINUE
200   CONTINUE
C
C *** TEST TO SEE IF ALL SYSTEMS HAVE BEEN ELIMINATED ***
C
      SW2=0
      DO 599 L=1,NOPRM
      DO 599 LL=1,INDEX
      DO 599 LLL=1,NSYS
        K=CHPRM(L)
        IF(MATRIX(K,LL,LLL).EQ.0)SW2=1
599   CONTINUE
      IF(SW2.EQ.0)GO TO 9190
      SW1=0
      DO 555 L=1,INDEX
      DO 555 LL=1,NSYS
      DO 555 LLL=1,NPARM
        IF(MATRIX(LLL,L,LL).EQ.1)SW1=1
555   CONTINUE
C
      LINE=34
      NPAGE=0
      CALL PAGER(LINE,NPAGE,0)
      WRITE(ITYOUT,5)(DBNAME(KK),KK=1,4),SYSDSN,
     & (SCNDSC(ICHOIC,M),M=1,15),I
      IF(SW1.EQ.0)WRITE(ITYOUT,4)
C
C *** CALL ELIMINATION TABLE ***
C
      CALL OVERLAY(3HSSM,4,1)
      REWIND IPP
C
C *** IF ALL SYSTEMS HAVE BEEN ELIMINATED DON'T PRINT UTILITY
C     VALUE TABLE ***
C
      IF(SW1.EQ.0)CALL EXIT
      GO TO 9190
C
C *** READ IN PARAMETER DATA ***
C
210   DO 300 J=1,INDEX
      READ(IPP,*)(PARAM(J,KL),KL=1,NSYS)
300   CONTINUE
      K=K+1
C
C *** TEST FOR WHICH TYPE OF PARAMETER & WHAT RANGE,IF ANY ***
C
      IF(RATED(I).EQ.1)GO TO 101
      IF(YN(I).EQ.1)GO TO 102
      IF(ABV(I).EQ.0.AND.BELW(I).EQ.0.AND.HIR(I).EQ.0.AND.
     &RLOWR(I).EQ.0)GO TO 103
      IF(ABV(I).EQ.0.AND.BELW(I).EQ.0)GO TO 104
      IF(ABV(I).EQ.0)GO TO 105
C
C *** NUMERICAL PARAMETER --  RANGE IS ABOVE ***
C
      DO 301 L=1,INDEX
      DO 301 LL=1,NSYS
      IVBIN=0
      DO 302 MM=1,NOPRM
      NKI=CHPRM(MM)
      IF(MATRIX(NKI,L,LL).EQ.0.AND.ISWNO(K).EQ.0)GO TO 303
302   CONTINUE
      IF(IVBIN.EQ.1)GO TO 301
      IF(ISWNO(K).EQ.1)GO TO 301
      IF(PARAM(L,LL).GE.ABV(I))GO TO 304
      DO 305 LM=1,NOPRM
      KII=CHPRM(LM)
C
C *** PARAMETER IS ELIMINATED ***
C
      MATRIX(KII,L,LL)=0
305   CONTINUE
      ELIM(L,LL,K)=I
      GO TO 301
```

```
C
C *** PARAMETER IS ALLOWED TO REMAIN ***
C
304   MATRIX(I,L,LL)=1
301   CONTINUE
      GO TO 200
C
C *** TEST TO SEE IF PARAMETER WOULD BE ELIMINATED ANYHOW ***
C
303   IF(PARAM(L,LL).LT.ABV(I))ELIM(L,LL,K)=I
      MATRIX(I,L,LL)=0
      IVBIN=1
      GO TO 302
C
C *** NUMERICAL PARAMETER -- RANGE IS BELOW ***
C
105   DO 401 L=1,INDEX
      DO 401 LL=1,NSYS
      IVBIN=0
      DO 402 MM=1,NOPRM
      NKI=CHPRM(MM)
      IF(MATRIX(NKI,L,LL).EQ.0.AND.ISWNO(K).EQ.0)GO TO 403
402   CONTINUE
      IF(IVBIN.EQ.1)GO TO 401
      IF(ISWNO(K).EQ.1)GO TO 401
      IF(PARAM(L,LL).LE.BELW(I))GO TO 404
      DO 405 LM=1,NOPRM
      KII=CHPRM(LM)
      MATRIX(KII,L,LL)=0
405   CONTINUE
      ELIM(L,LL,K)=I
      GO TO 401
404   MATRIX(I,L,LL)=1
401   CONTINUE
      GOTO 200
403   IF(PARAM(L,LL).GT.BELW(I))ELIM(L,LL,K)=I
      MATRIX(I,L,LL)=0
      IVBIN=1
      GO TO 402
C
C *** NUMERICAL PARAMETER -- RANGE IS IN BETWEEN ***
C
104   DO 501 L=1,INDEX
      DO 501 LL=1,NSYS
      IVBIN=0
      DO 502 MM=1,NOPRM
      NKI=CHPRM(MM)
      IF(MATRIX(NKI,L,LL).EQ.0.AND.ISWNO(K).EQ.0)GO TO 503
502   CONTINUE
      IF(IVBIN.EQ.1)GO TO 501
      IF(ISWNO(K).EQ.1)GO TO 501
      IF(PARAM(L,LL).GE.RLOWR(I).AND.PARAM(L,LL).LE.HIR(I))GO TO 504
      DO 505 LM=1,NOPRM
      KII=CHPRM(LM)
      MATRIX(KII,L,LL)=0
505   CONTINUE
      ELIM(L,LL,K)=I
      GO TO 501
504   MATRIX(I,L,LL)=1
501   CONTINUE
      GO TO 200
503   IF(PARAM(L,LL).LT.RLOWR(I).OR.PARAM(L,LL).GT.HIR(I))
     & ELIM(L,LL,K)=I
      MATRIX(I,L,LL)=0
      IVBIN=1
      GO TO 502
C
103   GO TO 200
C
C *** QUALATATIVE PARAMETER ***
C
102   DO 601 L=1,INDEX
      DO 601 LL=1,NSYS
      IVBIN=0
      DO 602 MM=1,NOPRM
      NKI=CHPRM(MM)
      IF(MATRIX(NKI,L,LL).EQ.0.AND.ISWNO(K).EQ.0)GO TO 603
602   CONTINUE
      IF(IVBIN.EQ.1)GO TO 601
      IF(PARAM(L,LL).EQ.1)GO TO 604
      DO 605 LM=1,NOPRM
      KII=CHPRM(LM)
      MATRIX(KII,L,LL)=0
605   CONTINUE
      ELIM(L,LL,K)=I
      GO TO 601
604   MATRIX(I,L,LL)=1
601   CONTINUE
      GO TO 200
603   IF(PARAM(L,LL).NE.1)ELIM(L,LL,K)=I
      MATRIX(I,L,LL)=0
      IVBIN=1
      GO TO 602
C
C *** RATED PARAMETER ***
C
101   IF(PTD(I).EQ.0)GO TO 200
      DO 701 L=1,INDEX
      DO 701 LL=1,NSYS
      IVBIN=0
      DO 702 MM=1,NOPRM
      NKI=CHPRM(MM)
      IF(MATRIX(NKI,L,LL).EQ.0.AND.ISWNO(K).EQ.0)GO TO 703
702   CONTINUE
      IF(IVBIN.EQ.1)GO TO 701
      IF(ISWNO(K).EQ.1)GO TO 701
      IF(PARAM(L,LL).LE.RTD(I))GO TO 704
      DO 705 LM=1,NOPRM
      KII=CHPRM(LM)
      MATRIX(KII,L,LL)=0
705   CONTINUE
      ELIM(L,LL,K)=I
      GO TO 701
704   MATRIX(I,L,LL)=1
701   CONTINUE
      GO TO 200
703   IF(PARAM(L,LL).GT.RTD(I))ELIM(L,LL,K)=I
      MATRIX(I,L,LL)=0
      IVBIN=1
      GO TO 702
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT(1X,I1)
2     FORMAT(A1)
3     FORMAT(I1)
4     FORMAT(1X,/,20X,32HALL SYSTEMS HAVE BEEN ELIMINATED)
5     FORMAT(1H ,72(1H*)/1X,5X,4A4,5X,5HCASE ,I1,3X,
     & 17HELIMINATION TABLE,/,1X,15A4,5X,5HPAGE ,I2,/,
     & 1X,72(1H*))
9190  CONTINUE
      END
C
C
C
C ***************************************************************
C ***************************************************************
C
      OVERLAY(SSM,4,1)
      PROGRAM TABLE
C
C **************************************************************
C
C     THIS ROUTINE FINDS WHICH SYSTEMS HAVE BEEN ELIMINATED
C     FROM THE DECISION PROCESS AND PRINTS THE REASONS WHY IT
C     WAS ELIMINATED.
C
C **************************************************************
C
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     &SYSSET(4),SB1SET(4),SB2SET(4),
     & SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/PARAM1/NOPRM,CHPRM(40),ABV(40),BELW(40),PLOWR(40),
     & HIP(40),RTD(40),IRANGE(40),ISWNO(40)
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
      COMMON/PARAM2/ELIM(7,10,40)
      COMMON/DB/DBNAME(4)
      INTEGER IQUALT(5,3),ELIM,DBNAME,SCNDSC
      INTEGER CHPRM,SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     &SUB2NM,RATED,YN
```

```
      DATA IQUALT(1,1)/4HEXCE/,IQUALT(1,2)/4HLLEN/,IQUALT(1,3)/4HT    /
      DATA IQUALT(2,1)/4HGOOD/,IQUALT(2,2)/4H    /,IQUALT(2,3)/4H    /
      DATA IQUALT(3,1)/4HFAIR/,IQUALT(3,2)/4H    /,IQUALT(3,3)/4H    /
      DATA IQUALT(4,1)/4HPOOR/,IQUALT(4,2)/4H    /,IQUALT(4,3)/4H    /
      DATA IQUALT(5,1)/4HVERY/,IQUALT(5,2)/4H POO/,IQUALT(5,3)/4HR   /
      WPITE(ITYOUT,101)
      WRITE(ITYOUT,102)(SCNDSC(ICHOIC,I),I=1,15)
C
C *** GO TO THE CORRECT CASE ***
C
      GO TO (1000,2000,3000),SYSDSN
C
C *** CASE 1 ***
C
1000      WPITE(ITYOUT,103)(SYSSET(I),I=1,4)
           LINE=14
      NPAGE=1
            DO 1100 L=1,NSYS
              LL=1
              DO 1200 LLL=1,NOPRM
                IF(ELIM(LL,L,LLL).EQ.0)GO TO 1200
C
C *** PAGING ***
C
      CALL PAGER (LINE,NPAGE,5)
      IF(LINE.EQ.0) WRITE (ITYOUT,1) (DBNAME(M),M=1,4),SYSDSN,
     & (SCNDSC(ICHOIC,M),M=1,15),NPAGE
      IF(LINE.EQ.0) LINE=4
                K=ELIM(LL,L,LLL)
C
C *** GO TO CORRECT PARAMETER ***
C
                IF(NUM(K).EQ.1)GO TO 1110
                IF(RATED(K).EQ.1)GO TO 1120
                IF(YN(K).EQ.1)GO TO 1130
1200          CONTINUE
1100        CONTINUE
      GO TO 9190
C
C *** NUMERICAL PARAMETERS ***
C
1110  GO TO (1111,1112,1113),IRANGE(LLL)
1111    WRITE(ITYOUT,104)(SYSNAM(L,M),M=1,4),(PARNAM(K,M),M=1,4),ABV(K)
           LINE=LINE+2
           GO TO 1200
1112  WPITE(ITYOUT,105)(SYSNAM(L,M),M=1,4),(PARNAM(K,M),M=1,4),
     & BELW(K)
           LINE=LINE+2
           GO TO 1200
1113  WRITE(ITYOUT,106)(SYSNAM(L,M),M=1,4),(PARNAM(K,M),M=1,4),
     & PLOWP(K),(PARNAM(K,M),M=1,4),HIR(K)
            LINE=LINE+5
            GO TO 1200
C
```

```
C *** RATED PARAMETERS ***
C
1120      JJ=IRANGE(LLL)
          WRITE(ITYOUT,107)(SYSNAM(L,M),M=1,4),(PARNAM(K,M),M=1,4),
     &     (IQUALT(JJ,M),M=1,3)
             LINE=LINE+2
             GO TO 1200
C
C *** QUALATATIVE PARAMETERS ***
C
1130      WRITE(ITYOUT,108)(SYSNAM(L,M),M=1,4),(PARNAM(K,M),M=1,4)
             LINE=LINE+2
             GO TO 1200
C
C *** CASE 2 ***
C
2000      WRITE(ITYOUT,109)(SYSSET(I),I=1,4),(SB1SET(I),I=1,4)
            LINE=14
      NPAGE=1
             DO 2100 L=1,NSYS
               DO 2200 LL=1,INDEX
                  DO 2300 LLL=1,NOPRM
                     IF(ELIM(LL,L,LLL).EQ.0)GO TO 2300
C
C *** PAGING ***
C
      CALL PAGER (LINE,NPAGE,5)
      IF (LINE.EQ.0) WRITE (ITYOUT,1) (DBNAME(M),M=1,4),SYSDSN,
     & (SCNDSC(ICHOIC,MM),MM=1,15),NPAGE
      IF (LINE.EQ.0) LINE=4
                     K=ELIM(LL,L,LLL)
                     IF(NUM(K).EQ.1)GO TO 2110
                     IF(RATED(K).EQ.1)GO TO 2120
                     IF (YN(K).EQ.1)GO TO 2130
2300              CONTINUE
2200           CONTINUE
2100         CONTINUE
      GO TO 9190
C
C *** NUMERICAL PARAMETERS ***
C
2110      GO TO (2111,2112,2113),IRANGE(LLL)
2111      WRITE(ITYOUT,110)(SYSNAM(L,M),M=1,4),(SUB1NM(LL,M),M=1,4),
     &      (PARNAM(K,M),M=1,4),ABV(K)
          LINE=LINE+2
             GO TO 2300
2112       WRITE(ITYOUT,111)(SYSNAM(L,M),M=1,4),(SUB1NM(LL,M),M=1,4),
     &       (PARNAM(K,M),M=1,4),BELW(K)
             LINE=LINE+2
             GO TO 2300
2113      WRITE(ITYOUT,112)(SYSNAM(L,M),M=1,4),(SUB1NM(LL,M),M=1,4),
     &      (PARNAM(K,M),M=1,4),RLOWR(K),(PARNAM(K,M),M=1,4),HIR(K)
             LINE=LINE+5
             GO TO 2300
```

```
C *** RATED PARAMETERS ***
2120      JJ=IRANGE(LLL)
2121      WRITE(ITYOUT,113)(SYSNAM(L,M),M=1,4),(SUB1NM(LL,M),M=1,4),
     &      (PARNAM(K,M),M=1,4),(IQUALT(JJ,M),M=1,3)
             LINE=LINE+2
             GO TO 2300
C *** QUALATATIVE PARAMETERS ***
2130      WRITE(ITYOUT,114)(SYSNAM(L,M),M=1,4),(SUB1NM(LL,M),M=1,4),
     &      (PARNAM(K,M),M=1,4)
             LINE=LINE+2
             GO TO 2300
C
C *** CASE 3 ***
C
3000  WRITE(ITYOUT,115)(SYSSET(I),I=1,4),(SB1SET(I),I=1,4),(SB2SET(I),
     &      I=1,4)
           LINE=14
           NPAGE=1
             DO 3100 L=1,NSYS
               INDXX=0
               DO 3200 L1=1,NSUB1
                 DO 3300 LL=1,NSUB2
                  INDXX=INDXX+1
                   J=INDXX
                   DO 3400 LLL=1,NOPRM
         IF(ELIM(J,L,LLL).EQ.0)GO TO 3400
C
C *** PAGING ***
C
                      CALL PAGER (LINE,NPAGE,5)
                      IF (LINE.EQ.0) WRITE (ITYOUT,1) (DBNAME(M),
     &               M=1,4),SYSDSN,(SCNDSC(ICHOIC,M),M=1,15),
     &               NPAGE
      IF (LINE.EQ.0) LINE=4
                     K=ELIM(J,L,LLL)
                     IF(NUM(K).EQ.1)GO TO 3110
                     IF(RATED(K).EQ.1)GO TO 3120
                     IF(YN(K).EQ.1)GO TO 3130
3400               CONTINUE
3300             CONTINUE
3200           CONTINUE
3100         CONTINUE
      GO TO 9190
C
C *** NUMERICAL PARAMETERS ***
C
3110      GO TO (3111,3112,3113),IRANGE(LLL)
3111      WRITE(ITYOUT,116)(SYSNAM(L,M),M=1,4),(SUB1NM(L1,M),M=1,4),
     &      (SUB2NM(L1,LL,M),M=1,4),(PARNAM(K,M),M=1,4),ABV(K)
             LINE=LINE+2
             GO TO 3400
3112      WRITE(ITYOUT,117)(SYSNAM(L,M),M=1,4),(SUB1NM(L1,M),M=1,4),
     &      (SUB2NM(L1,LL,M),M=1,4),(PARNAM(K,M),M=1,4),BELW(K)
             LINE=LINE+2
```

```
              GO TO 3400
3113   WRITE(ITYOUT,118)(SYSNAM(L,M),M=1,4),(SUB1NM(L1,M),M=1,4),
     & (SUB2NM(L1,LL,M),M=1,4),(PARNAM(K,M),M=1,4),RLOWP(K),
     & (PARNAM(K,M),M=1,4),HIR(K)
              LINE=LINE+5
              GO TO 3400
C
C *** RATED PARAMETERS ***
C
3120        JJ=IRANGE(LLL)
            WRITE(ITYOUT,119)(SYSNAM(L,M),M=1,4),(SUB1NM(L1,M),M=1,4),
     &        (SUB2NM(L1,LL,M),M=1,4),(PARNAM(K,M),M=1,4),
     &            (IQUALT(JJ,M),M=1,3)
              LINE=LINE+2
              GO TO 3400
C
C *** QUALATATIVE PARAMETERS ***
C
3130   WRITE(ITYOUT,120)(SYSNAM(L,M),M=1,4),(SUB1NM(L1,M),M=1,4),
     &(SUB2NM(L1,LL,M),M=1,4),(PARNAM(K,M),M=1,4)
              LINE=LINE+2
              GO TO 3400
C
C *** FORMAT STATEMENTS ***
C
1       FORMAT(1H1,72(1H*)/1X,5X,4A4,5X,5HCASE ,I1,3X,
     & 17HELIMINATION TABLE,/,1X,15A4,5X,5HPAGE ,I2,/,
     & 1X,72(1H*))
101     FORMAT (/30X,17HELIMINATION TABLE/)
102     FORMAT (10X,15A4,///)
103     FORMAT (11X,4A4,10X,24HREASONS FOR ELIMINATION ,/11X,
     & 16(1H-),10X,23(1H-)/)
104     FORMAT(1X,10X,4A4,10X,4A4,1X,1H<,F12.3)
105     FORMAT(1X,10X,4A4,10X,4A4,1X,1H>,F12.3)
106     FORMAT(1X,10X,4A4,10X,4A4,1H<,F12.3/1X,54X,2HOR/,1X,36X,
     & 4A4,1H>,F12.3)
107     FORMAT(1X,10X,4A4,10X,4A4,1H<,3A4)
108     FORMAT(1X,10X,4A4,10X,4A4)
109     FORMAT (1X,4A4,5X,4A4,5X,23HREASONS FOR ELIMINATION,/,
     &1X,16(1H-),5X,16(1H-),5X,23(1H-)/)
110     FORMAT(1X,4A4,5X,4A4,5X,4A4,1X,1H<,F12.3)
111     FORMAT(1X,4A4,5X,4A4,5X,4A4,1X,1H>,F12.3)
112     FORMAT(1X,4A4,5X,4A4,5X,4A4,1H<,F12.3,/1X,60X,2HOR,/1X,42X,
     & 4A4,1H>,F12.3)
113     FORMAT(1X,4A4,5X,4A4,5X,4A4,1X,1H<,1X,3A4)
114     FORMAT(1X,4A4,5X,4A4,5X,4A4)
115     FORMAT (57X,11HREASONS FOR,/1X,4A4,2X,4A4,2X,4A4,6X,
     & 11HELIMINATION,/1X,4(16(1H-),2X)/)
116     FORMAT(1X,4A4,2X,4A4,2X,4A4,2X,4A4,1X,1H<,F12.3)
117     FORMAT(1X,4A4,2X,4A4,2X,4A4,2X,4A4,1X,1H>,F12.3)
118     FORMAT(1X,4A4,2X,4A4,2X,4A4,2X,4A4,1H<,F12.3/1X,59X,2HOR/
     & ,1X,54X,4A4,1H>,F12.3)
119     FORMAT(1X,4A4,2X,4A4,2X,4A4,2X,4A4,2H <,3A4)
120     FORMAT(1X,4A4,2X,4A4,2X,4A4,2X,4A4)
```

```
9190  CONTINUE
      END
C
C ***********************************************************************
C ***********************************************************************
C
      OVERLAY(SSM,5,0)
      PROGRAM INVRT
C ***************************************************************
C     THIS ROUTINE INVERTS PARAMETER DATA SO THAT LOW VALUES
C     CONSTITUTE THE BEST UTILITY
C ***************************************************************
C
      COMMON/HDP1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),
     & SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      DIMENSION DUM(10),PARAM(85,10),VPARAM(85,10
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,PARNAM,
     & RATED,YN,SUB2NM
C
      REWIND IPP
      REWIND IVPARM
C
C *** INITIALIZE VPARAM TO ZERO ***
C
      DO 50 J=1,INDEX
      DO 50 JJ=1,NSYS
      VPARAM(J,JJ)=0
50    CONTINUE
C
C *** READ IN PARAMETER DATA ***
C
      DO 100 I=1,NPARM
          IF(INVERT(I).EQ.0)GO TO 101
C
             DO 300 K=1,INDEX
                 READ(IPP,*)(PARAM(K,KK),KK=1,NSYS)
300   CONTINUE
C
C *** FIND LARGEST VALUE FOR EACH SYSTEM ***
C
          DO 400 KK=1,NSYS
          BIG=0.0
           DO 450 K=1,INDEX
             IF(PARAM(K,KK).GT.BIG)BIG=PARAM(K,KK)
450        CONTINUE
C
C *** INVERT PARAMETER VALUES ***
C
      DO 460 L=1,INDEX
        IF(PARAM(L,KK).EQ.0)GO TO 460
        VPARAM(L,KK)=BIG/PARAM(L,KK)
```

```
460   CONTINUE
C
400   CONTINUE
C
C *** OUTPUT PARAMETER VALUES ***
C
      DO 500 L1=1,INDEX
         WRITE(IVPARM,*)(VPARAM(L1,LL1),LL1=1,NSYS)
500   CONTINUE
C
100   CONTINUE
C
      GO TO 9190
C
C *** IF PARAMETERS VALUES DON'T NEED INVERTING WRITE OUT
C *** PARAMETER VALUES ***
101   DO 200 J=1,INDEX
        READ(IPP,*)(PARAM(J,KLK),KLK=1,NSYS)
        WRITE(IVPARM,*)(PARAM(J,KMK),KMK=1,NSYS)
200   CONTINUE
      GO TO 100
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT(A1)
9190  CONTINUE
      END
C
C ************************************************************
C ************************************************************
C
      OVERLAY(SSM,6,0)
      PROGRAM UTILT
C
C ********************************************************
C
C     THIS ROUTINE DETERMINES THE SYSTEM VALUE OR UTILITY
C     FOR EACH SYSTEM
C
C ********************************************************
C
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),
     & SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      COMMON/RTNG/RATING(40)
      COMMON/PARAM3/MATRIX(40,7,10)
      COMMON/PARAM1/NOPRM,CHPRM(40),ABV(40),BELW(40),PLOWP(40),
     & HIP(40),RTD(40),IRANGE(40),IS.NO(40)
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON/DB/DBNAME(4)
      DIMENSION PARAM(85,10)
      INTEGER SYSDSN,SYSSET,SB1SET,SB2S&        &      1-    C&
     & PARNAM,RATED,YN
      INTEGER CHPRM,DBNAME
      DATA IYES/3HYES/
C
C *** INITIALIZE SYSNRM ***
C
      REWIND IVPARM
      DO 50 J=1,INDEX
      DO 50 JJ=1,NSYS
      SYSNRM(J,JJ)=0
50    CONTINUE
C
C *** FIND TOTAL SUM OF RATINGS ***
C
      SUMM=0
      DO 800 JI=1,NOPRM
      K=CHPRM(JI)
      SUMM=RATING(K) + SUMM
800   CONTINUE
C
C *** NORMALIZE RATINGS ***
C
      DO 850 LJ=1,NOPRM
      KR=CHPRM(LJ)
      RATING(KR)=RATING(KR)/SUMM
850   CONTINUE
C
C *** READ IN INVERTED PARAMETERS ***
C
      DO 100 I=1,NPARM
        DO 110 II=1,INDEX
          READ(IVPARM,*)(PARAM(II,III),III=1,NSYS)
110   CONTINUE
C
C *** ZERO OUT PARAMETERS AND FIND THE LARGEST & SMALLEST
C *** VALUES AMONG THE SYSTEMS
C
      DO 120 II=1,INDEX
        BIG=0.0
        SMALL = 1E20
          DO 130 III=1,NSYS
             PARAM(II,III)=MATRIX(I,II,III)*PARAM(II,III)
C
             IF(PARAM(II,III).EQ.0.0)GO TO 130
             IF(PARAM(II,III).LT.SMALL)SMALL=PARAM(II,III)
             IF(PARAM(II,III).GT.BIG)BIG=PARAM(II,III)
130   CONTINUE
C
C *** CALCULATE UTILITY ***
C
          DO 140 III=1,NSYS
            IF(PARAM(II,III).EQ.0.0)GO TO 140
            IF(BIG.EQ.SMALL)UTIL=1
            IF(BIG.EQ.SMALL)GO TO 909
```

```
               UTIL=((BIG-PARAM(II,III))/(BIG-SMALL))
909          PARAM(II,III)=UTIL
C
C *** CALCULATE RATED UTILTIY ***
C
      PARAM(II,III)=PARAM(II,III)*RATING(I)
C
C *** SUM RATED UTILITIES TO FIND SYSTEM VALUE ***
C
      IF(PARAM(II,III).EQ.0)GO TO 140
      SYSNRM(II,III)=PARAM(II,III) + SYSNRM(II,III)
140   CONTINUE
C
C *** NORMALIZE THE SYSTEM VALUE ***
C
C
120   CONTINUE
100   CONTINUE
C
C *** PRINT RESULTS IN A TABLE ***
C
      LINE=34
      NPAGE=0
      CALL PAGER(LINE,NPAGE,0)
      WRITE(ITYOUT,2)
      READ(ITTYIN,3)IANSR
      IF(IANSR.EQ.IYES)CALL OVERLAY(3HSSM,6,1)
        DO 1000 I=1,INDEX
        WRITE(ISYS,*)(SYSNRM(I,J),J=1,NSYS)
1000  CONTINUE
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT(I1)
2     FORMAT(//,1X,44HDO YOU WISH TO SEE TABULAR OUTPUT ? (YES/NO),
     & /)
3     FORMAT(A3)
      END
C
C *************************************************************
C *************************************************************
C
      OVERLAY(SSM,6,1)
      PROGRAM OUTPUT
C
C *********************************************************
C
C     THIS ROUTINE GIVES THE USER A CHOICE OF EITHER TEKTRONIX
C     GRAPHICS OR TABULAR OUTPUT.  THE OUTPUT CONSISTS OF SYSTEM
C     VALUES THAT HAVE DETERMINED WHICH SYSTEM IS OPTIMUM
C
C *********************************************************
C
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),
     & SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON/DB/DBNAME(4)
      COMMON/HDR2/NSCEN,SCNDSC(25,15),INDEX1,ICHOIC
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,RATED,YN,DBNAME,SCNDSC
      DIMENSION ICHAR(10),IOPT(10)
      DATA ICHAR/1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ/
      DATA IBLANK/1H /
C
      LINE=34
      NPAGE=0
      CALL PAGER(LINE,NPAGE,0)
C
      WRITE(ITYOUT,11)(DBNAME(L99),L99=1,4),SYSDSN,
     & (SCNDSC(ICHOIC,MM),MM=1,15),NPAGE
      WRITE(ITYOUT,1)
      WRITE(ITYOUT,4)(DBNAME(M),M=1,4)
      WRITE(ITYOUT,5)(SYSSET(M),M=1,4)
      LINE=9
      DO 1100 I=1,NSYS
        WRITE(ITYOUT,15)ICHAR(I),(SYSNAM(I,M),M=1,4)
        LINE=LINE+1
1100  CONTINUE
C
      GO TO (1000,2000,3000),SYSDSN
C
C *** CASE 1 ***
C
1000  CONTINUE
      BIG=0.0
      J=1
      DO 1010 I=1,NSYS
      IF(SYSNRM(J,I).GT.BIG)BIG=SYSNRM(J,I)
1010  CONTINUE
C
      DO 1090 KU=1,10
      IOPT(KU)=IBLANK
1090  CONTINUE
C
      ICOUNT=0
C
      DO 1020 I=1,NSYS
        IF(BIG.NE.SYSNRM(J,I))GO TO 1020
C
      ICOUNT=ICOUNT + 1
      IOPT(ICOUNT)=ICHAR(I)
1020  CONTINUE
C
      IF(BIG.NE.0)GO TO 1030
      WRITE(ITYOUT,6)
      GO TO 9190
C
C     TEKTRONIX PAGING
1030  CALL PAGER(LINE,NPAGE,6)
      IF (LINE.EQ.0) WRITE(ITYOUT,11) (DBNAME(M),M=1,4),SYSDSN,
     & (SCNDSC(ICHOIC,M),M=1,15),NPAGE
      IF (LINE.EQ.0) LINE=4
      CALL WRTE(IOPT,J)
      LINE=LINE+6
      GO TO 9190
C
C *** CASE 2 ***
C
2000  CONTINUE
C
           NCALL =0
         DO 2011 J=1,NSUB1
      CALL PAGER (LINE,NPAGE,10)
      IF (LINE.EQ.0) WRITE (ITYOUT,11) (DBNAME(M),M=1,4),SYSDSN,
     & (SCNDSC(ICHOIC,M),M=1,15),NPAGE
      IF (LINE.EQ.0) LINE=4
         WRITE(ITYOUT,7)(SUB1NM(J,M),M=1,4)
      LINE=LINE+4
            BIG=0.0
           DO 2010 I=1,NSYS
         IF(SYSNRM(J,I).GT.BIG)BIG=SYSNRM(J,I)
2010  CONTINUE
C
      DO 2090 KU=1,10
      IOPT(KU)=IBLANK
2090  CONTINUE
C
      ICOUNT=0
C
      DO 2020 I=1,NSYS
         IF(BIG.NE.SYSNRM(J,I))GO TO 2020
         ICOUNT=ICOUNT + 1
            IOPT(ICOUNT)=ICHAR(I)
2020  CONTINUE
C
      IF(BIG.NE.0)GO TO2030
        WRITE(ITYOUT,6)
        GO TO 2011
C
2030  CONTINUE
C
      CALL WRTE(IOPT,J)
      LINE=LINE+6
C
2011  CONTINUE
      GO TO 9190
C
C *** CASE 3 ***
C
```

```
3000  CONTINUE
      INDXXX=0
      BIG=0.0
        NPAGE=1
         DO 3011 K=1,NSUB1
            LINE=LINE+4
            WRITE (ITYOUT,7) (SUB1NM(K,M),M=1,4)
         DO 3012 KK=1,NSUB2
         CALL PAGER (LINE,NPAGE,9)
         IF (LINE.EQ.0) WRITE (ITYOUT,11) (DBNAME(M),M=1,4),SYSDSN,
     &    (SCNDSC(ICHOIC,M),M=1,15),NPAGE
         IF (LINE.EQ.0) LINE=4
3001      WRITE(ITYOUT,8)(SUB2NM(K,KK,M),M=1,4)
        LINE=LINE+3
            INDXXX=INDXXX+1
            J=INDXXX
             BIG=0.0
         DO 3010 I=1,NSYS
           IF(SYSNRM(J,I).GT.BIG)BIG=SYSNRM(J,I)
3010  CONTINUE
C
      DO 3090 KU=1,10
      IOPT(KU)=IBLANK
3090  CONTINUE
C
      ICOUNT=0
C
      DO 3020 I=1,NSYS
      IF(BIG.NE.SYSNRM(J,I))GO TO 3020
        ICOUNT=ICOUNT+1
      IOPT(ICOUNT)=ICHAR(I)
3020  CONTINUE
C
      IF(BIG.NE.0)GO TO 3030
      LINE=LINE+2
      WRITE(ITYOUT,6)
      GO TO 3012
C
3030  CONTINUE
C
      CALL WRTE(IOPT,J)
      LINE= LINE+6
3012  CONTINUE
3011  CONTINUE
C
C *** FORMAT STATEMENTS ***
C
1     FORMAT(1X,/)
3     FORMAT(I1)
4     FORMAT(1X,T25,*UTILITY VALUES FOR *,4A4/)
5     FORMAT(1X,T32,4A4/)
15    FORMAT(1X,T32,A1,* -- *,4A4)
6     FORMAT(1X,*ALL SYSTEMS HAVE BEEN ELIMINATED *)
7     FORMAT(1X,//,1X,4H*** ,4A4,4H ***,/,1X,16(1H-))
```

```
8      FORMAT(6X,4A4,/6X,16(1H-)/)
9      FORMAT(1X,//,1X,70(1H*)/,1X,70(1H*)/)
10     FORMAT(1X,//,1X,
     & 53H ***-ERROR-*** BAD INPUT--STOP EXECUTION & RESTART,/)
11     FORMAT(1H ,72(1H*)/1X,5X,4A4,5X,5HCASE ,I1,3X,
     & 20HUTILITY VALUES TABLE ,/1X,15A4,5X,5HPAGE ,I2,/,1X,
     & 72(1H*))
9190  CONTINUE
      END
C
C **************************************************************
C **************************************************************
C
      SUBROUTINE WRTE(IOPT,J)
C
C **********************************************************
C
C     CONTAINS THE WRITE STATEMENTS FOR THE UTILITY VALUE TABLE
C
C **********************************************************
C
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,
     & SYSSET(4),SB1SET(4),SB2SET(4),
     & SYSNAM(10,4),SUB1NM(20,4),SUB2NM(10,10,4),PARNAM(40,4),
     & NUM(40),RATED(40),YN(40),INVERT(40),INDEX
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON/UNITNO/ITTYIN,ITYOUT,IPPH,IUPPH,IPP,IUPP,IVPARM,ISYS
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,PARNAM,
     & RATED,YN
      DIMENSION ICHAR(10),IOPT(10)
      DATA ICHAR/1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ/
C
      GO TO (1101,1102,1103,1104,1105,1106,1107,1108,1109,1110),NSYS
C
1101  RETURN
1102  WRITE(ITYOUT,1)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
      WRITE(ITYOUT,2)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
1103  WRITE(ITYOUT,3)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
      WRITE(ITYOUT,4)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
1104  WRITE(ITYOUT,5)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
      WRITE(ITYOUT,6)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
1105  WRITE(ITYOUT,7)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
      WRITE(ITYOUT,8)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
1106  WRITE(ITYOUT,9)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
      WRITE(ITYOUT,10)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
1107  WRITE(ITYOUT,11)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
      WRITE(ITYOUT,12)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
1108  WRITE(ITYOUT,13)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
```

```
      WRITE(ITYOUT,14)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
1109  WRITE(ITYOUT,15)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
      WRITE(ITYOUT,16)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
1110  WRITE(ITYOUT,17)(ICHAR(I),I=1,NSYS),(SYSSET(M),M=1,4)
      WRITE(ITYOUT,18)(SYSNRM(J,K),K=1,NSYS),(IOPT(M),M=1,10)
      RETURN
C
C ***
C     FORMAT STATEMENTS
C ***
C
1     FORMAT(1X,18X,7HOPTIMUM,/1X,3X,A1,7X,A1,7X,4A4,/)
2     FORMAT(1X,2(F5.3,2X),5X,10A1,//)
3     FORMAT(1X,26X,7HOPTIMUM,/1X,3X,3(A1,6X),4A4,/)
4     FORMAT(1X,3(F5.3,2X),5X,10A1,//)
5     FORMAT(1X,31X,7HOPTIMUM,/1X,3X,4(A1,6X),4A4,/)
6     FORMAT(1X,4(F5.3,2X),5X,10A1,//)
7     FORMAT(1X,38X,7HOPTIMUM,,/,1X,3X,5(A1,6X),4A4,/)
8     FORMAT(1X,5(F5.3,2X),5X,10A1,//)
9     FORMAT(1X,46X,7HOPTIMUM,,/,1X,3X,6(A1,6X),4A4,/)
10    FORMAT(1X,6(F5.3,2X),5X,10A1,//)
11    FORMAT(1X,54X,7HOPTIMUM,,/,1X,3X,7(A1,6X),4A4,/)
12    FORMAT(1X,7(F5.3,2X),5X,10A1,//)
13    FORMAT(1X,62X,7HOPTIMUM,,/,1X,3X,8(A1,6X),4A4,/)
14    FORMAT(1X,8(F5.3,2X),5X,10A1,//)
15    FORMAT(1X,70X,7HOPTIMUM,,/,1X,3X,9(A1,6X),4A4,/)
16    FORMAT(1X,9(F5.3,2X),5X,10A1,//)
17    FORMAT(1X,72X,7HOPTIMUM,,/,1X,3X,10(A1,6X),4A4,/)
18    FORMAT(1X,10(F5.3,2X),5X,10A1,//)
      END
      OVERLAY(GRF,0,0)
      PROGRAM GRAPHX(INPUT,OUTPUT,HEADER,SYSNUM,TAPE10=HEADER,
     & TAPE15=SYSNUM,TAPE2=OUTPUT,TAPE5=INPUT)
C***********************************************************
C***                                                     ***
C* THIS PROGRAM DISPLAYS ON GRAPHS, USING THE TEKTRONIX    *
C* PLOT-10/TERMINAL CONTROL SYSTEM, THE OUTPUT OF THE      *
C* SYSTEM SELECTION MODEL PROGRAM.  TWO TYPES OF GRAPHS    *
C* CAN BE PRINTED, TIME GRAPHS(WHICH PLOT TIME VERSUS      *
C* SYSTEMS) OR SYSTEMS VERSUS THE OPTIMAL VALUES.  GRAPHS *
C* CAN VARY FROM GRAPHING TWO TO TEN SYSTEMS.              *
C***                                                     ***
C***********************************************************
C***********************************************************
C***                                                     ***
C*       DESCRIPTION OF VARIABLE NAMES                     *
C*                                                         *
C*  SYSDSN   -    INDICATES DESCRIPTION OF THE PROBLEM     *
C*                  1 - JUST SYSTEMS INCLUDED              *
C*                  2 - SYSTEMS AND LEVEL ONE SUBSYSTEMS   *
C*                  3 - SYSTEMS AND BOTH SUBSYSTEMS        *
C*  NSYS     -    NUMBER OF SYSTEMS                        *
C*  NSUB1    -    NUMBER OF LEVEL ONE SUBSYSTEMS           *
C*  NSUB2    -    LARGEST NO. OF LEVEL 2 SUBSYSTEMS        *
C*  NPARM    -    NUMBER OF PARAMETERS                     *
C*  SYSSET   -    GENERAL SETNAME FOR THE SYSTEMS          *
C*  SB1SET   -    GENERAL SETNAME FOR THE LEVEL ONE        *
C*  SB2SET   -    GENERAL SETNAME FOR THE LEVEL TWO        *
C*  SYSNAM   -    SYSTEM NAMES                             *
C*  SUB1NM   -    LEVEL ONE SUBSYSTEM NAMES                *
C*  SUB2NM   -    LEVEL TWO SUBSYSTEM NAMES                *
C*  PARNAM   -    PARAMETER NAMES                          *
C***                                                     ***
C***********************************************************
C***                                                     ***
C
C*** COMMON STATEMENTS ***
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON/GRAF/VAL(7),SYST(8),IYEARS(6),ISYST(15),ISIZE(15),
     & YARRAY(11),XAR(4),RSYS,IKEY(5),IONE(4),ITWO(4),ITHREE(4),
     & IFOUR(4),IFIVE(4),ISIX(4),ISEVEN(4),IEIGHT(4),ININE(4),
     & ITEN(5),SYSNA(2),SB1NME(2),SB2NME(2),ICOLON(4),IBAUD,JTERM
C
C*** INTEGER STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,VAL,SYST,SYSNA
      INTEGER SB1NME,SB2NME,NSYS2
      DATA INO/2HNO/,IYES/3HYES/
         REWIND ISYS
         REWIND IHDR
C
C*** DOES USER WANT A GRAPH? ***
C
      WRITE (ITYOUT,18)
18    FORMAT (1H ,43HDO YOU WISH TO SEE GRAPHIC OUTPUT? (YES/NO),/)
      READ (ITTYIN,19) IANSR
19    FORMAT (A3)
      IF (IANSR.NE.IYES) GO TO 999
C
C*** GET TEKTRONIX INITT (IBAUD,JTERM) PARAMETERS
      WRITE (ITYOUT,1)
1     FORMAT (1H ,45HENTER CHAR/SEC (I.E., 300 BAUD = 30 CHAR/SEC),/)
      READ (ITTYIN,*) IBAUD
      WRITE (ITYOUT,2)
2     FORMAT (1H ,20HENTER TERMINAL TYPE:,//,1H ,14H1=4010,4012/13,
     & /,1H ,9H2=4014/15,/,1H ,30H3=4014/15 WITH GRAPHICS MODULE,/)
      READ (ITTYIN,*) JTERM

      CALL OVERLAY(3HGRF,1,0)

      DO 100 I=1,INDEX
      READ(ISYS,*)(SYSNRM(I,J),J=1,NSYS)
100   CONTINUE

      RSYS=NSYS
C
C*** SETS VALUES FOR X-COORDINATES OF GRAPHS ***
C
      XAR(1)=-1.
      XAR(2)=RSYS
      XAR(3)=1.
      XAR(4)=1.

      IF(SYSDSN.EQ.1) CALL OVERLAY(3HGRF,2,0)
       IF(SYSDSN.EQ.2) CALL OVERLAY(3HGRF,3,0)
        IF(SYSDSN.EQ.3) CALL OVERLAY(3HGRF,4,0)

999   STOP
      END

      BLOCK DATA
      COMMON/GRAF/VAL(7),SYST(8),IYEARS(6),ISYST(15),ISIZE(15),
     & YARRAY(11),XAR(4),RSYS,IKEY(5),IONE(4),ITWO(4),ITHREE(4),
     & IFOUR(4),IFIVE(4),ISIX(4),ISEVEN(4),IEIGHT(4),ININE(4),
     & ITEN(5),SYSNA(2),SB1NME(2),SB2NME(2),ICOLON(4),IBAUD,JTERM
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
C
C*** DATA FOR GRAPHS WRITTEN IN ASC11 ***
C
      DATA IYEARS/5,89,69,65,82,83/
      DATA ISYST/14,83,89,83,84,69,77,32,32,86,65,76,85,69,83/
      DATA ISIZE/14,83,73,90,69,32,80,65,82,65,77,69,84,69,82/
      DATA VAL/6,86,65,76,85,69,83/
      DATA SYST/7,83,89,83,84,69,77,83/
      DATA IKEY/4,75,69,89,58/
      DATA ICOLON/3,32,32,58/
      DATA IONE/3,49,32,61/
      DATA ITWO/3,50,32,61/
      DATA ITHREE/3,51,32,61/
      DATA IFOUR/3,52,32,61/
      DATA IFIVE/3,53,32,61/
      DATA ISIX/3,54,32,61/
      DATA ISEVEN/3,55,32,61/
      DATA IEIGHT/3,56,32,61/
      DATA ININE/3,57,32,61/
      DATA ITEN/4,49,48,32,61/
      DATA ITTYIN,ITYOUT,IHDR,ISYS/2,5,10,15/
      END

      OVEPLAY(GRF,1,0)
C*********************************************************
C***                                                   ***
C* THIS OVERLAY READS IN THE NECESSARY DATA, OUTPUT FROM *
C* THE SYSTEM SELECTION MODEL PROGRAM.  THE DATA FILES   *
C* ARE "HEADER" AND "SYSNUM"; THEY MUST BE ATTACHED BE-  *
C* FORE THE PPOGRAM WILL EXECUTE.                        *
C***                                                   ***
C*********************************************************
C***                                                   ***
      PPOGRAM READR
C
C*** COMMON STATEMENTS ***
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/DB/DBNAME(2)
      COMMON/PARAM4/SYSNRM(85,10)
C
C *** INTEGER STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,DBNAME
C
C *** READ IN DATA BASE NAME ***
C
      READ(IHDR,3)(DBNAME(M),M=1,2)
C
C *** READ IN SYSTEM DESIGN ***
C
      READ(IHDR,1)SYSDSN
C
C *** READ IN NO. OF SYSTEMS,SUBSYSTEMS,PARAMETERS ***
```

```
C
      READ(IHDR,2)NSYS
      READ(IHDR,2)NSUB1
      READ(IHDR,2)NSUB2
      READ(IHDR,2)NPARM
      IF(NSYS.EQ.0) GO TO 600
C
C *** READ IN SETNAMES ***
C
      READ(IHDR,3)(SYSSET(I),I=1,2)
      IF(SYSDSN.GE.2)READ(IHDR,3)(SB1SET(I),I=1,2)
      IF(SYSDSN.EQ.3)READ(IHDR,3)(SB2SET(I),I=1,2)
C
C*** READ IN SYSTEM NAMES ***
C
      DO 100 I=1,NSYS
       READ(IHDR,3)(SYSNAM(I,J),J=1,2)
100   CONTINUE
      IF(NSUB1.EQ.0)GO TO 400
C
C *** READ IN SUBSYSTEM LEVEL ONE NAMES ***
C
      DO 200 I=1,NSUB1
       READ(IHDR,3)(SUB1NM(I,J),J=1,21
200   CONTINUE
      IF(NSUB2.EQ.0) GO TO 400
C
C *** READ SUBSYSTEM LEVEL TWO NAMES ***
C
      DO 300 K=1,NSUB1
      DO 300 I=1,NSUB2
       READ(IHDR,3)(SUB2NM(K,I,J),J=1,2)
300   CONTINUE
C
400   CONTINUE
C
C *** READ IN PARAMETER NAMES AND PARAMETER CHAPACTERISTICS ***
C
      DO 500 I=1,NPARM
       READ(IHDR,4)(PARNAM(I,J),J=1,2),NUM(I),RATED(I),YN(I),
     & INVERT(I)
500   CONTINUE
      GO TO 700
600   WRITE(ITYOUT,5)
      CALL EXIT

C
C *** CALCULATE INDEX FOR POSITIONING FILES ***
C
700   CONTINUE

      IF(NSUB1.EQ.0) GO TO 800
      IF(NSUB2.EQ.0) GO TO 900
        INDEX=NSUB1*NSUB2
```

```
            GO TO 1000
800       INDEX=1
            GO TO 1000
900       INDEX=NSUB1
1000  CONTINUE
C
C ***FOPMAT STATEMENTS ***
C
1     FORMAT(I1)
2     FORMAT(I2)
3     FORMAT(A10,A6)
4     FORMAT(A10,A6,I1,I1,I1,I1)
5     FORMAT(1X,37HERROR IN HEADER -- NO. OF SYSTEMS= 0 )
      END


      OVEPLAY(GRF,2,0)
C*********************************************************
C***                                                   ***
C* THIS OVERLAY PRINTS OUT ONE GRAPH COMPARING ALL THE   *
C* SYSTEMS INVOLVED.                                     *
C***                                                   ***
C*********************************************************

      PPOGRAM GRAF1
C
C*** COMMON STATEMENTS ***
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON/GRAF/VAL(7),SYST(8),IYEARS(6),ISYST(15),ISIZE(15),
     & YARRAY(11),XAR(4),RSYS,IKEY(5),IONE(4),ITWO(4),
     & ITHREE(4),IFOUR(4),IFIVE(4),ISIX(4),ISEVEN(4),
     & IEIGHT(4),ININE(4),ITEN(5),SYSNA(2),SB1NME(2),SB2NME(2)
     & ,ICOLON(4),IBAUD,JTERM
C
C*** INTEGER STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PAPNAM,RATED,YN,VAL,SYST,SYSNA,NSUM,SB1NME,SB2NME
     & ,NSYS
      NSUM=0
          YARRAY(1)=RSYS
      CALL INITT (IBAUD,JTEPM)
      CALL TERM (JTERM,4096)
      DO 1100 I=1,NSYS
       II=I+1
C
C*** SET Y-VALUES FROM SYSTEM VALUES ***
C
```

```
          IR=8
      CALL NOTATE(2200,200,IEIGHT(1),IEIGHT(2))
        IF(IR.GE.NSYS) GO TO 280
          IR=9
      CALL NOTATE(2200,100,ININE(1),ININE(2))
        IF(IR.GE.NSYS) GO TO 280
          IR=10
      CALL NOTATE(2200,0,ITEN(1),ITEN(2))
280   CONTINUE

      DO 212 MSYS=1,NSYS
      IF (MSYS.LE.5) ISYSPL=MSYS
      IF (MSYS.GT.5) ISYSPL=MSYS-5
      CALL MOVABS (1230,400-100*(ISYSPL-1))
      IF (MSYS.GT.5) CALL MOVREL (1200,0)
      DO 313 I=1,2
313   SYSNA(I)=SYSNAM(MSYS,I)
      CALL AOUTST (20,SYSNA)
212   CONTINUE
C
C*** PRINTS SYSTEM SETNAMES ***
C
1101  CALL MOVABS(1000,500)
      CALL AOUTST(20,SYSSET)
C
C*** DELAY COMMAND NEEDS ANY ONE INPUT TO CONTINUE ***
C
      CALL TINPUT(K)

      CALL FINITT(0.,700.)
      END


      OVERLAY(GRF,3,0)
C*****************************************************************
C***                                                           ***
C* THIS OVERLAY PRINTS OUT GRAPHS OF RATING VALUES VERSUS        *
C* SYSTEMS.  EACH OF THE POSSIBLE GRAPHS INCLUDES THE NAMES      *
C* OF THE FIRST SUBSET AND THE SYSTEM SETNAMES.                  *
C***                                                           ***
C*****************************************************************
C***                                                           ***
      PROGRAM GRAF2

C
C*** COMMON STATEMENTS ***
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHOR,ISYS
      COMMON/HOR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON/GRAF/VAL(7),SYST(8),IYEARS(6),ISYST(15),ISIZE(15),
     & YARRAY(11),XAR(4),RSYS,IKEY(5),IONE(4),ITWO(4),
     & ITHREE(4),IFOUR(4),IFIVE(4),ISIX(4),ISEVEN(4),
     & IEIGHT(4),ININE(4),ITEN(5),SYSNA(2),SB1NME(2),SB2NME(2)
     & ,ICOLON(4),IBAUD,JTERM
C
C*** INTEGER STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,RATED,YN,VAL,SYST,SYSNA,NSUM,SB1NME,SB2NME
      NSUM=0
      DO 100 NOW=1,NSUB1
       YARRAY(1)=RSYS
      CALL INITT (IBAUD,JTERM)
      CALL TERM (JTERM,4096)
      DO 2100 I=1,NSYS
      II=I+1
C
C*** SET Y-VALUES FROM SYSTEM VALUES ***
C
       YARRAY(II)=SYSNRM(NOW,I)
2100  CONTINUE

C
C*** INITIALIZES TERMINAL AND TERMINAL STATUS AREA ***
C
      CALL BINITT
C
C*** LIMITS OF COORDINATES OF GRAPHS ***
C
      CALL DLIMX(0.,RSYS+1.)
      CALL DLIMY(0.,1.)
      CALL SLIMY(900,2775)

C
C*** PRINTING OF DATA POINTS ON GRAPHS ***
C
      IDEN=NSYS/3+2
      CALL XDEN(IDEN)
      CALL XFRM(1)
      IBARWD=6000/(3*(RSYS+2.))
      CALL VBARST (8,IBARWD,100)
      CALL CHECK(XAR,YARRAY)
      CALL DSPLAY(XAR,YARRAY)
      CALL FRAME
C
C*** LABELING OF GRAPHS ***
C
      CALL MOVABS(100,2500)
      CALL VLABEL(ISYST(1),ISYST(2))

      CALL NOTATE (1910,600,SYST(1),SYST(2))
      CALL NOTATE (600,500,IKEY(1),IKEY(2))
           IR=1
      CALL NOTATE(1000,400,IONE(1),IONE(2))
```

```
        IF(IR.GE.NSYS)GO TO 290
            IR=2
      CALL NOTATE(1000,300,ITWO(1),ITWO(2))
        IF(IR.GE.NSYS)GO TO 290
            IR=3
      CALL NOTATE(1000,200,ITHREE(1),ITHREE(2))
        IF(IR.GE.NSYS)GO TO 290
            IR=4
      CALL NOTATE(1000,100,IFOUR(1),IFOUR(2))
        IF(IR.GE.NSYS)GO TO 290
            IR=5
      CALL NOTATE(1000,0,IFIVE(1),IFIVE(2))
        IF(IR.GE.NSYS)GO TO 290
            IR=6
      CALL NOTATE(2200,400,ISIX(1),ISIX(2))
        IF(IR.GE.NSYS)GO TO 290
            IR=7
      CALL NOTATE(2200,300,ISEVEN(1),ISEVEN(2))
        IF(IR.GE.NSYS)GO TO 290
            IR=8
      CALL NOTATE(2200,200,IEIGHT(1),IEIGHT(2))
        IF(IR.GE.NSYS)GO TO 290
            IR=9
      CALL NOTATE(2200,100,ININE(1),ININE(2))
        IF(IR.GE.NSYS)GO TO 290
            IR=10
      CALL NOTATE(2200,0,ITEN(1),ITEN(2))
290   CONTINUE

      DO 212 MSYS=1,NSYS
      IF (MSYS.LE.5) ISYSPL=MSYS
      IF (MSYS.GT.5) ISYSPL=MSYS-5
      CALL MOVABS (1230,400-100*(ISYSPL-1))
      IF (MSYS.GT.5) CALL MOVREL (1200,0)
      DO 313 I=1,2
313   SYSNA(I)=SYSNAM(MSYS,I)
      CALL AOUTST (20,SYSNA)
212   CONTINUE
C
C*** LABELING SYSTEM SETNAMES ***
C
1131  CALL MOVABS(1000,500)
      CALL AOUTST(20,SYSSET)
C
C*** LABELING LEVEL ONE SUBSYSTEM SETNAMES ***
C
      CALL MOVABS(1200,3150)
      CALL AOUTST(20,SB1SET)
      CALL NOTATE(2100,3150,ICOLON(1),ICOLON(2))

      DO 117 IRE=1,2
C
C*** RENAMING OF SUBSYSTEM ONE LEVEL NAMES ***
C
```

```
      SB1NME(IRE)=SUB1NM(NOW,IRE)

117   CONTINUE
C
C*** LABELING FIRST LEVEL SUBSYSTEMS ***
C
      CALL MOVABS(2300,3150)
      CALL AOUTST(20,SB1NME)
C
C*** DELAY COMMAND; NEEDS ONE INPUT TO CONTINUE ***
C
      CALL TINPUT(K)

100   CONTINUE
      CALL FINITT(0.,700.)
      END


      OVERLAY(GRF,4,0)
C*****************************************************
C***                                              ***
C* THIS OVERLAY PRINTS 4 GRAPHS OF RATING VALUES VER  *
C* SUS SYSTEMS.  EACH OF THE POSSIBLE GRAPHS INCLUDES *
C* THE NAMES OF THE FIRST AND SECOND SUBSETS AND THE  *
C* SYSTEM SETNAMES AND NAMES.                         *
C***                                              ***
C*****************************************************
C***                                              ***
      PROGRAM GRAF3
C
C*** COMMON STATEMENTS ***
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
      COMMON/HDP1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON/GRAF/VAL(7),SYST(8),IYEARS(6),ISYST(15),ISIZE(15),
     & YARRAY(11),XAR(4),RSYS,IKEY(5),IONE(4),ITWO(4),
     & ITHREE(4),IFOUR(4),IFIVE(4),ISIX(4),ISEVEN(4),
     & IEIGHT(4),ININE(4),ITEN(5),SYSNA(2),SB1NME(2),SB2NME(2)
     & ,ICOLON(4),IBAUD,JTERM
C
C*** INTEGER STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,SUB2NM,
     & PARNAM,RATED,YN,VAL,SYST,SB1NME,NSUM,SB2NME,SYSNA
      NSUM=0
         INDX=0
      CALL INITT (IBAUD,JTERM)
      CALL TERM(JTERM,4096)
      DO 3200 L=1,NSUB1
      DO 3200 LL=1,NSUB2
      CALL NEWPAG
        INDX=INDX+1
         YAPRAY(1)=RSYS
       DO 3100 I=1,NSYS
         II=I+1
C
C*** SET Y-VALUES FROM SYSTEM VALUES ***
C
      YARRAY(II)=SYSNRM(INDX,I)

3100   CONTINUE
C
C*** INITIALIZES TERMINAL AND TERMINAL STATUS AREA ***
C
      CALL BINITT
C
C*** LIMITS OF COORDINATES OF GRAPHS ***
C
      CALL DLIMX(0.,RSYS+1.)
      IDEN=NSYS/3+2
      CALL XDEN(IDEN)
      CALL XFRM(1)
      IBARWD=6000/(3*(RSYS+2.))
      CALL VBARST (8,IBARWD,100)
      CALL DLIMY(0.,1.)
      CALL SLIMY(900,2775)

C
C*** PRINTING OF DATA POINTS ON GRAPHS ***
C
      CALL CHECK(XAR,YARRAY)
      CALL DSPLAY(XAR,YARRAY)
      CALL FRAME
C
C*** LABELING OF GRAPHS ***
C
      CALL NOTATE(1910,600,SYST(1),SYST(2))
      CALL MOVABS(100,2500)
      CALL VLABEL(ISYST(1),ISYST(2))

      CALL NOTATE(600,500,IKEY(1),IKEY(2))
           IR=1
      CALL NOTATE(1000,400,IONE(1),IONE(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=2
      CALL NOTATE(1000,300,ITWO(1),ITWO(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=3
      CALL NOTATE(1000,200,ITHREE(1),ITHREE(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=4
      CALL NOTATE(1000,100,IFOUR(1),IFOUR(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=5
      CALL NOTATE(1000,0,IFIVE(1),IFIVE(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=6
      CALL NOTATE(2200,400,ISIX(1),ISIX(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=7
      CALL NOTATE(2200,300,ISEVEN(1),ISEVEN(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=8
      CALL NOTATE(2200,200,IEIGHT(1),IEIGHT(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=9
      CALL NOTATE(2200,100,ININE(1),ININE(2))
        IF(IR.GE.NSYS)GO TO 260
           IR=10
      CALL NOTATE(2200,0,ITEN(1),ITEN(2))
260   CONTINUE

      DO 212 MSYS=1,NSYS
      IF (MSYS.LE.5) ISYSPL=MSYS
      IF (MSYS.GT.5) ISYSPL=MSYS-5
      CALL MOVABS (1230,400-100*(ISYSPL-1))
      IF (MSYS.GT.5) CALL MOVREL (1200,0)
      DO 313 I=1,2
313   SYSNA(I)=SYSNAM(MSYS,I)
      CALL AOUTST (20,SYSNA)
212   CONTINUE
1161  CALL MOVABS(1000,500)
      CALL AOUTST(20,SYSSET)
      CALL MOVABS(1200,3160)
      CALL AOUTST(20,SB1SET)
      CALL NOTATE (2100,3160,ICOLON(1),ICOLON(2))
      DO 118 ITE=1,2
      SB1NME(ITE)=SUB1NM(L,ITE)
118   CONTINUE
      CALL MOVABS(2300,3160)
      CALL AOUTST(20,SB1NME)
      CALL MOVABS(1200,3060)
      CALL AOUTST(20,SB2SET)
      CALL NOTATE (2100,3060,ICOLON(1),ICOLON(2))
      DO 450 IER=1,2
      SB2NME(IER)=SUB2NM(L,LL,IER)
450   CONTINUE
      CALL MOVABS(2300,3060)
      CALL AOUTST(20,SB2NME)
      CALL TINPUT(K)
3200  CONTINUE
      CALL FINITT(0.,700.)
      END
      OVERLAY (GRF,0,0)
      PROGRAM GRAPHT(INPUT,OUTPUT,HEADER,SYSNUM,TAPE10=HEADER,
     & TAPE15=SYSNUM,TAPE5=INPUT,TAPE2=OUTPUT)
C**********************************************************************
C***                                                                ***
C* THIS PROGRAM USES DATA FILES HEADER AND SYSNUM TO CREATE A         *
C* VERTICAL BAR GRAPH OF SYSTEM NUMBERS VERSUS SYSTEM RATING          *
C* VALUES, OBTAINED FROM THE MAIN PROGRAM SSMP.  NORMAL LIMITS        *
C* ON PROBLEM SIZE ARE THE SAME AS ALWAYS, AND THE NUMBER OF          *
C* GRAPHS PRODUCED IS EQUAL TO INDEX.                                 *
C***                                                                ***
C**********************************************************************
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON /GRAF/ ISYST(15),XARRAY(4),RSYS,IBAUD,JTERM
C
C*** INTEGER STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,VAL,SYST,SYSNA
      INTEGER SB1NME,SB2NME,NSYS2
      DATA IYES/3HYES/
C
C*** DOES USER WANT TO SEE TIME GRAPH? ***
C
      WRITE (ITYOUT,18)
18    FORMAT (1X,32HDO YOU WISH TO SEE A TIME GRAPH?,/)
      READ (ITTYIN,19) IANSR
19    FORMAT (A3)
      IF (IANSR.NE.IYES) GO TO 999
C
      REWIND IHDR
      REWIND ISYS
C
C*** READ IN DATA FROM HEADER FILE ***
C
      CALL OVERLAY (3HGRF,1,0)
C
C*** GET SYSNUM VALUES INTO SYSNRM ***
C
      DO 100 I=1,INDEX
         READ (ISYS,*) (SYSNRM(I,J),J=1,NSYS)
100   CONTINUE
C
      RSYS=NSYS
      WRITE (ITYOUT,2)
2     FORMAT (1H ,45HENTER CHAR/SEC (I.E., 300 BAUD = 30 CHAR/SEC),/)
      READ (ITTYIN,*) IBAUD
      WRITE (ITYOUT,3)
```

```
3     FORMAT (1H ,20HENTER TERMINAL TYPE:,//,1H ,14H1=4010,4012/13,
     & /,1H ,9H2=4014/15,/,1H ,30H3=4014/15 WITH GRAPHICS MODULE,/)
      READ (ITTYIN,*) JTERM
C
C*** IBAUD AND JTERM ARE USED TO CALL INITT IN OVERLAYS ***
C
      IF (SYSDSN.EQ.1) GO TO 1000
      IF (SYSDSN.EQ.2.AND.NSUB1.NE.5) GO TO 1000
      IF (SYSDSN.EQ.3.AND.NSUB2.NE.5) GO TO 1000
C
C*** ERROR CONDITIONS--PROBLEM IS RESTRICTED TO 5 TIMES ***
C
C*** NOW CALL APPROPRIATE OVERLAY ***
C
      IF (SYSDSN.EQ.2) CALL OVERLAY (3HGRF,2,0)
      IF (SYSDSN.EQ.3) CALL OVERLAY (3HGRF,3,0)
C
      GO TO 999
1000  WRITE (ITYOUT,1)
1     FORMAT (1H ,36HPROBLEM UNSUITABLE FOR TIME GRAPHS -,/,1H ,
     & 43HMUST HAVE EXACTLY 5 LEVEL 1 OR 2 SUBSYSTEMS)
999   STOP
      END
C
C**********************************************************************
C***                                                                ***
                            BLOCK DATA
C***                                                                ***
C**********************************************************************
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON /GRAF/ ISYST(15),XARRAY(4),RSYS,IBAUD,JTERM
C
C*** INTEGER STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,VAL,SYST,SYSNA
      INTEGER SB1NME,SB2NME,NSYS2
C
      DATA ISYST/14,83,89,83,84,69,77,32,32,86,65,76,85,69,83/
      DATA ITTYIN,ITYOUT,IHDR,ISYS/2,5,10,15/
      DATA XARRAY/-1.,5.,1.,1./
      END
C
      OVERLAY(GRF,1,0)
C***************************************************************
C***                                                         ***
C* THIS OVERLAY READS IN THE NECESSARY DATA, OUTPUT FROM     *
C* THE SYSTEM SELECTION MODEL PROGRAM.  THE DATA FILES       *
C* ARE "HEADER" AND "SYSNUM"; THEY MUST BE ATTACHED BE-      *
```

```
C* FORE THE PROGRAM WILL EXECUTE.                                      *
C***                                                                 ***
C***********************************************************************
C***                                                                 ***
      PROGRAM READR
C
C*** COMMON STATEMENTS ***
C
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
      COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/DB/DBNAME(2)
      COMMON/PARAM4/SYSNRM(85,10)
C
C *** INTEGER STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,DBNAME
C
C *** READ IN DATA BASE NAME ***
C
      READ(IHDR,3)(DBNAME(M),M=1,2)
C
C *** READ IN SYSTEM DESIGN ***
C
      READ(IHDR,1)SYSDSN
C
C *** READ IN NO. OF SYSTEMS,SUBSYSTEMS,PARAMETERS ***
C
      READ(IHDR,2)NSYS
      READ(IHDR,2)NSUB1
      READ(IHDR,2)NSUB2
      READ(IHDR,2)NPARM
      IF(NSYS.EQ.0) GO TO 600
C
C *** READ IN SETNAMES ***
C
      READ(IHDR,3)(SYSSFT(I),I=1,2)
      IF(SYSDSN.GE.2)READ(IHDR,3)(SB1SET(I),I=1,2)
      IF(SYSDSN.EQ.3)READ(IHDR,3)(SB2SET(I),I=1,2)
C
C*** READ IN SYSTEM NAMES ***
C
      DO 100 I=1,NSYS
       READ(IHDR,3)(SYSNAM(I,J),J=1,2)
100   CONTINUE
      IF(NSUB1.EQ.0)GO TO 400
C
C *** READ IN SUBSYSTEM LEVEL ONE NAMES ***
C
      DO 200 I=1,NSUB1
       READ(IHDR,3)(SUB1NM(I,J),J=1,2)
```

```
200    CONTINUE
       IF(NSUB2.EQ.0) GO TO 400
C
C *** READ SUBSYSTEM LEVEL TWO NAMES ***
C
       DO 300 K=1,NSUB1
       DO 300 I=1,NSUB2
        READ(IHDR,3)(SUB2NM(K,I,J),J=1,2)
300    CONTINUE
C
400    CONTINUE
C
C *** READ IN PARAMETER NAMES AND PARAMETER CHARACTERISTICS ***
C
       DO 500 I=1,NPARM
        READ(IHDR,4)(PARNAM(I,J),J=1,2),NUM(I),RATED(I),YN(I),
      & INVERT(I)
500    CONTINUE
       GO TO 700
600    WRITE(ITYOUT,5)
       CALL EXIT

C
C *** CALCULATE INDEX FOR POSITIONING FILES ***
C
700    CONTINUE

       IF(NSUB1.EQ.0) GO TO 800
       IF(NSUB2.EQ.0) GO TO 900
         INDEX=NSUB1*NSUB2
             GO TO 1000
800        INDEX=1
             GO TO 1000
900        INDEX=NSUB1
1000   CONTINUE
C
C ***FORMAT STATEMENTS ***
C
1      FORMAT(I1)
2      FORMAT(I2)
3      FORMAT(A10,A6)
4      FORMAT(A10,A6,I1,I1,I1,I1)
5      FORMAT(1X,37HERROR IN HEADER -- NO. OF SYSTEMS= 0 )
       END
C
       OVERLAY (GRF,2,0)
       PROGRAM GRAF2
C***************************************************************
C***                                                         ***
C* THIS OVERLAY GRAPHS THE CASE 2 DATA, 1 CURVE FOR EACH SYSTEM,*
C* ON 1 GRAPH AS TIME (THE LEVEL 1 SUBSYSTEM) VS. SYSTEM VALUES.*
C***                                                         ***
C***************************************************************
C
```

```
      COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
      COMMON/HDP1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
      COMMON/PARAM4/SYSNRM(85,10)
      COMMON /GRAF/ ISYST(15),XARRAY(4),RSYS,IBAUD,JTERM
C
C*** INTEGEP STATEMENTS ***
C
      INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,VAL,SYST,SYSNA
      INTEGER SB1NME,SB2NME,NSYS2 .
      DIMENSION YARRAY(6),ILABEL(2),SYSNA(2)
C
C*** INITIALIZE TEKTRONIX SYSTEM ***
C
      CALL INITT (IBAUD,JTERM)
      CALL TERM(JTERM,4096)
      CALL BINITT
C
C*** SET LIMITS FOR GRAPHS ***
C
      CALL DLIMX (1.,5.)
      CALL DLIMY (0.,1.)
      CALL SLIMY (900,2800)
      YARRAY(1)=RSYS
C
C*** SET UP Y-VALUES ***
C
      DO 10 ISYSN=1,NSYS
         DO 11 J=1,5
11       YARRAY(J+1)=SYSNRM(J,ISYSN)
C
C*** SET PARAMETERS FOR GRAPH AND DO IT TO IT ***
C
         CALL XLAB(0)
         CALL SYMBL(ISYSN)
         CALL XDEN(1)
         CALL CHECK(XARRAY,YARRAY)
         IF (ISYSN.NE.1) GO TO 2000
C
C*** (ONLY CALL DSPLAY ON 1ST TIME THROUGH,ELSE USE CPLOT ***
C
         CALL DSPLAY (XARRAY,YARRAY)
         GO TO 1999
2000  CALL CPLOT (XARRAY,YARRAY)
1999  CONTINUE
C
C*** NOW OUTPUT SYMBOL AND RESPECTIVE SYSTEM NAME ***
C
         IF (ISYSN.LE.5) ISYSPL=ISYSN
         IF (ISYSN.GT.5) ISYSPL=ISYSN-5
         CALL MOVABS (600,600-100*ISYSPL)
```

```
            IF (ISYSN.GT.5) CALL MOVREL (1600,0)
            CALL SYMOUT (ISYSN,1.)
            CALL MOVREL (100,-30)
            DO 12 I=1,2
12          SYSNA(I)=SYSNAM(ISYSN,I)
            CALL AOUTST (20,SYSNA)
C
10      CONTINUE
C
C*** WRITE TITLE,AXIS LABELS ***
C
        DO 20 I=1,5
            CALL MOVABS (490+(I-1)*750,700)
            DO 21 J=1,2
21          ILABEL(J)=SUB1NM(I,J)
            CALL AOUTST (20,ILABEL)
20      CONTINUE
C
        CALL MOVABS(100,2500)
        CALL VLABEL (ISYST(1),ISYST(2))
        CALL MOVREL (0,-100)
        CALL TINPUT (K)
C
C*** TINPUT WAITS FOR INPUT OF ANY CHARACTER WITH ETX ***
C
        STOP
        END
C
        OVERLAY (GRF,3,0)
        PROGRAM GRAF3
C****************************************************************
C***                                                          ***
C* THIS OVERLAY CREATES (NSUB1) GRAPHS OF THE CASE 3 DATA.    ***
C***                                                          ***
C****************************************************************
        COMMON/UNITNO/ITTYIN,ITYOUT,IHDR,ISYS
        COMMON/HDR1/SYSDSN,NSYS,NSUB1,NSUB2,NPARM,SYSSET(2),
     & SB1SET(2),SB2SET(2),SYSNAM(10,2),SUB1NM(20,2),
     & SUB2NM(10,10,2),PARNAM(40,2),NUM(40),RATED(40),
     & YN(40),INVERT(40),INDEX
        COMMON/PARAM4/SYSNRM(85,10)
        COMMON /GRAF/ ISYST(15),XARRAY(4),RSYS,IBAUD,JTERM
        DIMENSION YARRAY(6),ILABEL(2),SYSNA(2),ICOLON(4)
C
C*** INTEGER STATEMENTS ***
C
        INTEGER SYSDSN,SYSSET,SB1SET,SB2SET,SYSNAM,SUB1NM,
     & SUB2NM,PARNAM,RATED,YN,VAL,SYST,SYSNA
        INTEGER SB1NME,SB2NME,NSYS2
        DATA ICOLON/3,32,32,58/
C
        DO 800 ITIME=1,NSUB1
            CALL INITT (IBAUD,JTERM)
            CALL BINITT
```

```
C
      CALL DLIMY(0.,1.)
      CALL DLIMX(1.,5.)
      CALL SLIMY (900,2800)
C
      YARRAY(1)=RSYS
      DO 10 ISYSN=1,NSYS
        DO 11 J=1,5
11      YARRAY (J+1)=SYSNRM(J,ISYSN)
C
        CALL XLAB(0)
        CALL SYMBL(ISYSN)
        CALL CHECK (XARRAY,YARRAY)
        IF (ISYSN.NE.1) GO TO 2000
        CALL DSPLAY (XARRAY,YARRAY)
        GO TO 1999
2000    CALL CPLOT (XARRAY,YARRAY)
1999    CONTINUE
C
        IF (ISYSN.LE.5) ISYSPL=ISYSN
        IF (ISYSN.GT.5) ISYSPL=ISYSN-5
        CALL MOVABS (600,600-100*ISYSPL)
        IF (ISYSN.GT.5) CALL MOVREL (1600,0)
        CALL SYMOUT (ISYSN,1.)
        CALL MOVREL (100,-30)
        DO 12 I=1,2
12      SYSNA(I)=SYSNAM(ISYSN,I)
        CALL AOUTST (20,SYSNA)
10    CONTINUE
C
      DO 20 I=1,5
        CALL MOVABS (490+(I-1)*750,700)
        DO 21 J=1,2
21      ILABEL(J)=SUB2NM(ITIME,I,J)
        CALL AOUTST (20,ILABEL)
20    CONTINUE
C
      CALL MOVABS (100,2500)
      CALL VLABEL (ISYST(1),ISYST(2))
      CALL MOVABS (1200,3150)
      CALL AOUTST (20,SB1SET)
C
      DO 41 J=1,2
41    ILABEL(J)=SUB1NM(ITIME,J)
      CALL NOTATE (2100,3150,ICOLON(1),ICOLON(2))
      CALL MOVABS (2300,3150)
      CALL AOUTST (20,ILABEL)
800 CALL TINPUT(K)
C
    STOP
    END
```

ATE

LME